Financial markets, Innovation, and Acquisitions

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To Alessia, and to my parents

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Introduction

In this thesis I analyze how financial markets characteristics and financial markets conditions affects corporate innovation and the market for corporate control.

In the first chapter, I review the growing literature on finance and innovation. Focusing on technological innovation, I survey numerous recent contributions on the relation between arm's-length financial systems and relationship-based financial systems and innovation. I discuss the role of financial markets, banks, private equity and venture capital firms in shaping firms innovative activities. I lay out the theoretical and empirical work on the relation between financing sources and innovative investments.

In the second chapter, I investigate the role of stock market development in promoting innovation. I exploit the London Big Bang, a large shock to stock market regulation that occurred in the United Kingdom in 1986, to show that improved stock market conditions foster innovation. I find that more external finance dependent firms increase their innovation output following the London Big Bang. I identify a possible mechanism through which stock market development promotes innovation: more external finance dependent firms rely more on equity financing and less on long term loans after the deregulation.

In the third chapter, we analyze how the composition of the M&A deal flow varies over time. The question is relevant because different acquirer types affect targets differently. We link financial sponsors and strategic buyers activity in the euro area between 2000 and 2015 to the conditions in the debt and stock markets. We find that deal flows for different types of buyers are not synchronous. In particular, we find that the relative contribution of financial sponsors grows with credit tightness, drops when the difference between their credit risk premium and that of strategic buyers widens, and drops when stock market valuations rise. While the credit risk premium affects the propensity to embark on a transaction for different buyer types, credit availability and stock market valuations affect strategic buyers' deal size.

Contents

Chapter 1

Innovation and Finance: A Survey

Ostinelli, D., Innovation and Finance: A Survey, Working Paper, 2016.

I Introduction

The present survey reviews the academic research on finance and innovation. It is motivated by three main reasons. First, the role of innovation in supporting economic growth is very important and has been understood by economists at least since the 1950s. While Schumpeter (1934) already focused on the role of innovation as a pivotal stimulus to economic growth, Solow (1957) decomposed output into capital and labour inputs and stresses the importance of technical change for economic growth. Second, the literature debating the impact of finance on growth evolved significantly since the seventies. Goldsmith (1969) analyzes 35 countries between 1860 and 1963 and finds a connection between economic and financial development, but he acknowledges that it is not possible to establish the direction of the causal mechanism. More recent research has gone a step further: King and Levine (1993) find that pre-determined level of financial development predicts long-run economic growth, and in their widely cited paper Rajan and Zingales (1998) show that financial development helps disproportionately firms that are typically dependent on external finance for their growth. The third motivation of this survey is that the literature on finance and innovation, both on the theory and especially on the empirical side, has grown dramatically in the last few years, constituting a valuable microeconomic complement to the better established macroeconomic analysis of the relation between finance and economic growth. The range of novel papers is very wide: there are papers that examine the effect of stock-markets and banks on innovation, of stock-market deregulation, of interstate and intrastate banking deregulation, of IPOs and LBOs, of takeovers regulation and bankruptcy codes, of sell-side research analysts, of venture capitalists and institutional investors, and of credit squeezes. This survey seeks to include these recent findings, to extend previous surveys and to identify some potential topics for future research.

Following Rajan and Zingales (2001), I divide financial systems in two categories: the arm's-length (or market-based) system and the relationship-based (or bank dominated) system. These two systems differ over several dimensions: the importance of the insti-

tutional relationships between the financier and the firm, the degree of reliance on legal enforcement, and the importance of transparency.[1] While some papers discussed in this survey perform a comparative analysis between the two systems, the survey's purpose is not to determine which system is best suited to finance innovation. Instead, this survey examines recent papers showing how the characteristics of these two systems, or a modification of these characteristics, affects the financing of innovation.

I begin this survey by examining how arm's length system's peculiarities affect corporate innovation and the theory underlying these empirical studies. While in certain circumstances agency costs related to financial markets may deter innovation, there is a stronger evidence showing the positive effect of bond and especially stock-markets in nurturing firms' innovation by relaxing firms' financing constraints, generating useful information for investors, and monitoring managers. Still, firms changing their organizational status from private to public may suffer in terms of innovation quality, with skilled inventors leaving the firm after the IPO and remaining inventors experiencing a decline in productivity. In addition, increasing stock liquidity may deter innovation, because of increased exposure to hostile takeovers and higher presence of non-dedicated institutional investors.

As an ideal bridge between arm's-length and relationship-based financial systems, I then review the literature directly comparing these two systems. From a theoretical perspective, arm's-length financing generates more public information, which eventually leads to more novel innovation. On the contrary, relationship-based financing is better suited to fund less innovative projects or incremental innovations. Empirical evidence shows indeed that firms with a greater proportion of equity financing and public debt outstanding in their capital structure innovate more, and better.

Continuing with this line of inquiring, I focus the rest of this survey on papers linking relationship-based systems and innovation, which include banks, venture capitalists (VCs) and private equity firms (leveraged buyouts, or LBOs). First, this survey analyses the literature on banking and innovation, which is mostly devoted to assessing

[1] See Rajan and Zingales (2001) for a more comprehensive discussion.

the impact of a supply shock of banking capital on innovation. In general, an increase (decrease) of credit supply spurs (hurts) innovation, but increasing competition in the banking market may also damage banking relationships and eventually may deter innovation.

Second, I move to the VCs and innovation literature, which tries to understand how these financial intermediaries affect the innovation output of the companies in which they invest. A part from one notable exception, empirical evidence demonstrates the positive role exerted by VCs not only in selecting firms with high innovation potential, but also in stimulating firms' innovation by providing advice and monitoring. Finally, I analyze the literature on LBOs and innovation. Recent empirical findings demonstrate the positive effect of LBOs in relaxing financial constraints and find no evidence that they sacrifice innovative investments.

Several other surveys cover topics related to mine, but with different perspectives.[2] O'Sullivan (2004) covers the literature on finance and innovation, reviewing Schumpeter's work and analyzing the scarce attention that finance has been accorded as a stimulus for innovation. A more comprehensive review of theoretical and empirical research on the connections between the operation of the financial system and economic growth is Levine (2005). Although in his theoretical part the author includes many papers relating the financial system and innovative projects, the empirical part is mostly devoted to studies linking financial system and broad economic growth. In addition, Hall and Lerner (2010) study the financing of innovative firms from a theoretical and empirical point of view. In their empirical section they focus mainly on papers using R&D expenditure as a proxy for investment in innovative activities, while more recent papers predominantly use patent counts and patent citations as measures of innovation. Da Rin et al. (2011) in their detailed review on venture capital academic research, include a section with theoretical and empirical research on the relationship between venture capital financing and innovation. Azoulay and Lerner (2012) review the liter-

[2]It shall be noted that this survey is focused on technological innovation, which includes new products and processes as well as significant changes in products and processes. Therefore, organizational innovation, which is the adoption of new management techniques and their consequences for firm performance, lies beyond the scope of this work (see Bloom and Van Reenen (2010) for a detailed review).

ature on technological innovation and organization. The authors examine not only the financing of innovation, focusing mainly on the role played by venture capital, but they also analyse the link between internal organization and innovation. Focusing on one of the most widely accepted innovation measure, Lerner and Seru (2015) provide a very detailed review on the empirical use of patents as a proxy of innovation activity. In particular, their paper highlights the patent application process, the relevance of patent data to finance researchers, the major resources through which they can be accessed but also the main issues that can make its analysis problematic.

Perhaps the work most closely related to mine is Kerr and Nanda (2014), where the authors discuss the recent findings in financing innovation. Relative to their paper, I follow Rajan and Zingales (2001) and I group theory and empirical findings under the two polar forms of financing, namely relationship-based systems and arm's length system.[3] Beside using this structure, I compare these two systems from a theoretical and empirical perspective. Second, I provide new evidence mitigating the concern that agency costs associated with being a publicly-traded firm can deter innovation, as for example in the context of sell-side research analysts coverage and innovation. Third, I complete and extend the literature on banking and innovation. Finally, I extend the fast growing empirical literature in VCs and LBOs and I discuss the theoretical models underlying these studies.

The remainder of the paper is organized as follows. Section 2 analyses how arm's length financing affects corporate innovation, both from a theoretical and an empirical perspective. Section 3 covers theoretical and empirical research in relationship-based financial systems. Section 4 discusses some areas for future research as well as future challenges for regulators and policy makers.

[3]Rajan and Zingales (2003) provide further insights on these two forms of financing. In particular, arm's lenght financing is prevalent in the US but has becoming increasingly more important in Europe since the 1980s.

II Arm's lenght financial systems and innovation

Financial markets can affect firms' innovation by alleviating financing constraints (and therefore financing positive NPV projects that otherwise would not be financed), by generating information, by providing incentives and feedback to managers and by monitoring them. While, in principle, these functions shall be positive for innovation, researchers have also found some negative externalities that potentially deter innovation. More specifically, the literature on arm's length financing has compared the different firms' financing opportunities offered by financial markets, their advantages and disadvantages, and analysed how financial markets' characteristics and the functions they perform may affect firms' innovative behaviour. Although this section is mostly devoted to the relationship between stock-markets and innovation, I also analyse the (relatively smaller) bond-markets and innovation literature when I survey some papers directly comparing arm's length and relationship-based financial systems.

While financial systems link together entrepreneurs and savers, different costs can make a specific contract preferable for this purpose. These costs consist in acquiring information, enforcing contracts, and making transactions. Before making investment decisions, there are large costs associated with evaluating firms, managers, and market conditions. Financial intermediaries may reduce the cost of acquiring such information and greater information can improve investment decisions, thereby accelerating economic growth. This has been modelled first by Greenwood and Jovanovic (1989). In a framework with capital constrained entrepreneurs, the authors show that financial intermediaries collect and analyze information and fund more promising firms. Further theoretical work analyses the relationship between financial markets and innovation with that same information production perspective. An interpretation by Levine (2005) of the work by Acemoglu et al. (2003) is that financial development will reduce financing (credit) constraints and therefore affect innovative activities (which in their model are opposed to the so-called "investment-based strategies").

Starting with Hall (1993), researchers have extensively studied the relation between

innovation and financial markets characteristics from an empirical perspective. Among her first papers, Hall (1993) documents the contribution of R&D and investments to stock-market's valuation. In particular, she finds that the stock-market valuation of R&D intangible assets from the mid seventies to the mid eighties was higher than the valuation from mid eighties to early nineties. Even though the paper does not disentangle among the several possible explanations leading to a fall in the R&D valuation, it nonetheless provides an indication of financial markets' feedbacks, which could be used by managers in making investment decisions. Although not only related to innovation, an important contribution in understanding whether a firm's stock price affects its investment, or more generally the relation between markets and investments, is Bakke and Whited (2010).[4] With a novel empirical approach they address the following two questions: do market signals provide new knowledge to managers (or should managers ignore these signals)? And are managers reluctant to issue equity to exploit over valuation of their companies' shares? While they find limited evidence that firms invest after issuing overpriced equity, they find that the portion of the variation in Tobin's q that is relevant for investment rises with the amount of private investor information that is included in the stock price.

A recent paper by Levine et al. (2015) empirically assesses the enforcement of insider trading laws on innovation: such enforcement reduces the ability of corporate insiders to trade on private information and could encourage outsiders to invest more in researching firms. On the one hand, the resulting additional information produced may improve firms' valuation, and markets that fully value innovation should provide the right incentive to firms to invest more in new products. On the other hand, to the extent that the enforcement of insider trading laws increases stock liquidity, a countervailing effect may potentially harm the information production function and eventually innovation: as highlighted by Grossman and Stiglitz (1980), when stock markets quickly reveal information, they reduce the incentive to produce information for private investors. First,

[4]Bakke and Whited (2010) take the sum of capital expenditures and research and development (R&D) as measure of investment.

Levine et al. (2015) use a difference-in-differences approach and find that the enforcement of insider trading laws in 97 countries led to a significant increase in innovation, measured with five different proxies reflecting intensity, scope, impact, generality and originality of patents. Furthermore, they narrow their identification strategy to address several interpretation challenges and find that innovation increases more in industries that are more innovative, opaque, equity dependent and that have more liquid shares. This is consistent with the view that insider trading laws make investors more keen to invest their money in R&D intensive firms and the subsequent improvement in company valuation creates the right incentive for these firms to invest in innovation.

Focusing on the monitoring function, Atanassov (2013) analyses hostile takeovers, which represent one of the strongest corporate governance mechanisms. By exploiting the enactment of Business Combination anti-takeover laws in the US as an exogenous decrease in the threat of hostile takeovers, Atanassov (2013) finds that firms incorporated in states that pass anti-takeover laws innovate less after the law is passed. Moreover, he finds that the reduction in innovation generated by anti-takeover laws is mitigated, although not perfectly, by alternative monitoring mechanism such as the presence of a large shareholder or an activist pension fund, for companies with financial leverage and for firms belonging to industry with high product market competition. These results are consistent with Aghion et al. (2013) on the role of institutional investors on innovation. In particular, the authors ask the following question: did the rise in institutional ownership increased short-termism? To put it differently, did the pressure for quarterly results discouraged managers from undertaking innovative projects? With a panel dataset of over 800 major US firms over the 1990s they show that there is a robust positive relation between innovation and institutional ownership structure. By exploiting an exogenous increase in institutional ownership that follows the addition of a stock to the Standard and Poor's (S&P) 500, they show that this has a positive effect on innovation, suggesting that the effect of institutions on innovation is positive and causal.

Focusing on intrinsic differences at industry level, further empirical research tries to determine how financial markets development and their characteristics may affect firms' innovation. Hsu et al. (2014) compare innovation across countries and find that more external finance dependent industries exhibit a disproportionally higher innovation level in countries with better developed equity markets, while the development of credit markets discourages innovation in more external finance dependent industries. An even more detailed analysis of credit market characteristics has been performed by Acharya and Subramanian (2009), who analyze the impact of bankruptcy codes on innovation. The underlying idea is that there is a conflict of interest between equity holders and creditors at the time of distress. Performing a cross-countries comparison, the authors find that in countries with strong creditor rights technologically innovative industries grow more slowly. The challenge when assessing empirically the effect of financial development on innovation is that innovation may be endogenous with company and financial market conditions, including stock-market characteristics. To overcome this obstacle, Ostinelli (2016a) uses a quasi natural experiment setting to examine the reaction of firms to a significant event of financial markets deregulation and finds that an improvement in stock-market development promotes firm level innovation, both in terms of patent counts and in terms of patent citations. Specifically, the paper exploits the London Big Bang, a large and exogenous shock to stock market regulation that occurred in the United Kingdom in 1986. The London Big Bang, following the removal of membership restrictions to the London Stock Exchange and the elimination of fixed trade commissions, substantially increased the daily turnover on the exchange and facilitated firms' raising of capital. First, the paper shows that firms belonging to high external finance dependent industries increase innovation after the Big Bang. Additionally, as a potential mechanism through which stock-market development fosters innovation, Ostinelli (2016a) finds that more external finance dependent firms rely more on equity financing and less on long term loans after the deregulation. Acharya and Xu (2015) similarly find that listed firms belonging to high external finance depen-

dent industries spend more on R&D and generate a better patent portfolio than their private counterparts, while public firms in internal finance dependent industries do not innovate neither more nor better than their private counter parts. An early important contribution in this field is Brown et al. (2009), which focuses on the determinants of R&D financing. In particular, they analyse the period from 1994 to 2004 in the US, which saw a dramatic boom, then a subsequent decline, in R&D spending. Virtually all of the 1990s U.S. R&D boom was concentrated in seven high-tech industries and was accounted for by young firms (publicly traded for fewer than 15 years) in these industries. Brown, Fazzari and Petersen (2009) argue that the R&D boom and the subsequent drop was driven by a large and positive shift in the supply of equity, both internal (cash flow) and external.

In contrast to Levine et al. (2015) who show that the effect on innovation of increased stock liquidity generated by the enforcement of insider trading laws is offset by a higher amount available information, Fang et al. (2014) come to different results. Exploiting decimalization as a large and exogenous shock to stock liquidity, Fang et al. (2014) find that firms experiencing the largest increase in liquidity following the decimalization produced 3.5 fewer patents in the three years period immediately after the decimalization relative to the three years period immediately before the decimalization. As channels through which liquidity affects innovation, Fang et al. (2014) indicate increased takeover exposure and the presence of non-dedicated institutional investors.[5]

Focusing on the incentives that financial markets generate when selecting between different investment projects, Holmstrom (1989) develops a principal agent model to explain how agency costs affect the choice of projects. Building on explicit models that feature myopic behaviour, Holmstrom (1989) argues that innovation, which tends to pay off in the distant rather than the near future, will not be undertaken sufficiently often by listed firms. The problem tends to be even more severe in large firms, because they have more flexibility and independence. Ferreira et al. (2014) compare conventional projects with innovative projects for private and public firms and show that it is opti-

[5]Dedicated investors have concentrated portfolio holdings and low portfolio turnover (see Bushee (1998)).

mal to remain public when exploiting conventional projects and optimal to go private when exploring innovative projects. In particular, the opacity of private firms increases insiders' tolerance for failures and makes them more inclined to invest in innovative projects. Building on this, Bernstein (2015) focuses on the potential disadvantages of being listed in public equity markets, for instance managerial agency problems that may deter innovation activity. Using NASDAQ fluctuations as an instrument for IPO completion, Bernstein (2015) finds that going public significantly reduces firms' innovation quality following the departure of skilled inventors and a decline in the quality of innovation produced by inventors who remained at the firm.

A further interesting debate related to information production considers the effect of analysts coverage on innovation. Sell-side research analysts provide their clients with investment advice, which derives from their own valuations of the firms they cover. When sell-side research analysts modify their firm valuations, often following new earnings estimates, they may provide updated investment recommendations, which in turn moves stock prices. For this reason, firm managers pay particular attention to recommendations; consequently, recommendations could impose short-term pressure, exacerbate myopic behaviour, affect investment decisions and eventually deter innovation. Still, sell-side research analysts may contribute to reducing information asymmetry by collecting information and helping current and potential investors understand investments in innovation. Thus, this effect may counterbalance the induced myopic behaviour, such that the management of the firm would not refrain from investing in value-enhancing innovation projects. He and Tian (2013) test these alternative hypotheses and find that an increase in the number of sell-side research analyst reduces firm's innovation output, consistent with the hypothesis that analysts exert pressure on managers who sacrifice innovation projects to meet short term earning targets. This striking result has been further examined by Clarke et al. (2015), who conclude that the negative relation between analyst coverage and innovation outputs is driven by what the authors call poor quality innovators. In particular, Clarke et al. (2015) stratify the sample based on

the firm's past innovation quality, measured by patent citations. Interestingly, Clarke et al. (2015) find that sell-side research analysts discourage innovation in firms with multiple patents yet few citations, while they encourage innovation in the most productive firms. Still, if an analyst's decision to follow a firm is driven by the firm's future innovation output or if there is unobservable firm heterogeneity correlated with both analyst coverage and innovation, findings may be biased. Therefore, Clarke et al. (2015) exploit two plausible quasi-natural experiments, namely brokerage closures and brokerage mergers. In each of this two cases, an observed firm loses one analyst for reasons unrelated to the characteristics of the firms covered by their sell-side research analysts. Brokerage closures are motivated by business strategy considerations of the brokerage houses themselves, while in the case of brokerage mergers, redundant analysts often leave the merged entity. Thus, if a stock is covered by two merging brokerage houses before the merger and an analyst leaves the merged entity, analyst coverage decreases. In addition, they also use an instrumental variable introduced in Yu (2008) and they confirm their previous findings. Clarke et al. (2015) paper is particularly important because it lessens the concern that agency costs related to public stock-markets deter innovation. On the contrary, the authors show that sell-side research analysts recognize past innovative success and contribute reducing less valuable innovation.

Summing up, empirical research has confirmed theoretical works showing the positive role of financial markets in stimulating innovation. In particular, there is growing evidence mitigating the concern that agency costs associated with being a publicly-traded firm can deter innovation, as for example Levine et al. (2015) in the context of insider trading and innovation, Ostinelli (2016a) in the context of financial development and innovation, and Clarke et al. (2015), which revisits the conflict between analysts coverage and innovation. While stock liquidity or going public may lead to inventors' mobility and inventors' productivity changes, financial markets generally help firms in financing their projects, including innovative investments.

I conclude this section by surveying the theoretical and empirical works comparing

arm's length systems and relationship-based systems. Rajan and Zingales (2001) and Rajan and Zingales (2003) analyze these two systems from a historical and geographic perspective, discuss their costs and benefits and assess their performance contingent upon different degrees of market and firm size, legal enforcement, and transparency. With regard to innovation, Rajan and Zingales (2001) suggest that arm's length financing allows investors to evaluate independently the portfolio of innovative projects of the firm and therefore it is better suited to finance more revolutionary innovation. In normal times instead, when change is incremental, relationship-based financing is better suited to finance (relatively less novel) innovation.

Building on this, and keeping in mind the theoretical framework of Holmstrom (1989), Atanassov (2014) uses a panel of public firms to test whether their innovative activity is related to the source of their external financing. Atanassov (2014) finds first that firms with a greater proportion of arm's length financing such as public debt and equity have a larger number of patents and these patents are more significant in terms of influencing subsequent patents. Moreover, these firms have more volatile patents and higher score of originality and generality, suggesting that firms with public debt financing and a greater proportion of equity financing create more innovations in new technological fields. On the debt side this result is somewhat surprising and, combined with Acharya and Subramanian (2009), adds further evidence that public debt can play a positive role in promoting firm innovation.

Then, Atanassov (2014) focuses on bank financing, and finds that firms borrowing from multiple banks have more novel innovations. The intuition, provided by Rajan and Zingales (2003), is the following: if firms borrow from multiple banks, there is a greater probability that at least one bank will fund the project. Furthermore, multiple banks lending is more of an arm's length relationship than borrowing from a single bank. In addition, Atanassov (2014) finds that firms with credit lines are more innovative, while firms with term loans are less innovative than otherwise similar firms. Finally, firms with stricter covenants receive fewer citations per patent; the intuition is that loans

that are more covenant-light allow more flexibility.

III Relationship-based financial systems and innovation

III.I Banking and innovation

In recent years a growing body of literature has analysed the relationship between the banking system and innovation. The topic is particularly interesting because it is commonly believed that debt, and in particular bank debt, is not well suited to finance innovative projects. In this section I briefly review the theoretical literature in this field before turning to the empirical literature, which mainly exploits positive and negative shocks to credit supply to assess the importance of bank lending in financing innovative projects.

Banks, and more in general financial institutions, generally emerge in response to capital market imperfections and provide important functions which potentially mitigate frictions related to investments in innovation. These functions include generating information, monitoring, and risk pooling. King and Levine (1993) present a model in which financial intermediaries select entrepreneurs and provide external finance in their initiation of innovative activity, increasing the probability of successful innovation. De la Fuente and Marín (1996) develop a framework for analysing the interaction between output growth and financial development (in a context in which both are endogenous). They show that financial intermediaries contribute to growth by collecting information (in terms of monitoring) which, by improving their ability to provide risk-pooling services, facilitates the flow of resources to risky innovative activities. In particular, monitoring lessens the moral hazard problem arising from the combination of risk aversion (on the part of investors) and private information in research (on the part of entrepreneurs). Therefore, more efficient financial systems should generate more innovation.

Bencivenga and Smith (2001) construct a model in which banks channel savings to investment, affecting resource allocations in ways that have implications for real growth

rates, causing intermediation to be growth promoting. In particular, the presence of intermediaries permits an economy to reduce the fraction of its savings held in the form of unproductive liquid assets, and to prevent misallocations of invested capital due to liquidity needs.

Building on the theoretical intuition of King and Levine (1993), one of the first empirical papers investigating the complex link between the development of the banking sector and innovation at the firm level is Benfratello et al. (2008). By matching banking development data in Italy (they rely on branch density by province, calculated as the number of branches divided by population) and survey data on innovation activities of Italian manufacturing firms, they conclude that banking development affects the probability of process innovation, in particular for firms in high-tech sectors, in sectors more dependent on external finance, and for firms that are small, while the evidence for product innovation is much weaker and not robust.[6] Ayyagari et al. (2007) analyze firm innovation activity in emerging markets and find that financing from foreign banks is associated with higher levels of innovation compared to financing from domestic banks.

While these papers have been able to demonstrate a relationship between innovation and banking development, they have little to say about causality: is it the flourishing banking system that causes innovation or is it the presence of more innovative firms that attract bank lending? In order to address this issue, several papers exploit exogenous regulatory policies affecting the US banking system, namely interstate and intrastate banking deregulation. On the one hand, following the interstate banking deregulation acts passed during the 1980s and 1990s, out-of-state bank holding companies were allowed to acquire banks chartered in the deregulating states. This led to an increase in the credit supply, facilitated banks' geographic diversification of credit risk, and was associated with better screening and monitoring technologies. On the other hand, with intrastate banking deregulation, passed in different states from the early 1970s to the mid-1990s, banks were allowed to expand within state borders, which intensified

[6] A product innovation is the introduction of a new good or service, while process innovation refers to the introduction of new methods, equipment or skills. More formally, product innovation is formalized as an upward shift in the demand curve, while process innovation lowers the marginal cost of production Mantovani (2006).

banking competition and increased the size of banks.

Amore et al. (2013) exploit interstate deregulation and find that increasing bank competition had significant beneficial effects on the quantity and quality of innovation activities. Cornaggia et al. (2015) find (apparently) opposite results: increasing banking competition cause states' innovation outputs to decline. Still, their further analyses provide a different picture: while public corporations with headquarters in a deregulated state reduce their patenting output, both in terms of patent counts and in terms of patent citations, private firms experience increases in innovation output following the deregulatory events. Their hypothesis is that improved competition in banking provides good access to finance to small, privately-held, innovative firms that are likely targets and this expansion of credit will reduce the relative attractiveness of being acquired.

In order to address the problem that lending relationships and innovation may not be random (i.e. they are likely to be endogenous to firm characteristics that may be correlated with innovation activity), Hombert and Matray (2012) use intrastate banking deregulation, with the aim of isolating the effect of a shock to lending relationships with no change in banks' ability to diversify geographically, since diversification benefits are lower for within-state expansion compared to across states diversification.

After proxying for relationship dependence at the firm level by its degree of opacity, they find that innovation decreases following intrastate deregulation. In particular, the negative effect of deregulation is stronger in more relationship-dependent industries, while the effect is never significant in industries less reliant on relationships. They motivate their results as evidence of an increase in competition damaging lending relationships and increasing credit constraints for lending relationship-dependent firms.

Both interstate and intrastate banking deregulation in the US have been exploited also by Chava et al. (2013). According to the previous literature (see for example Berger et al. (2014) banks play an important role in financing young, private firms. The authors therefore focus on firms with these characteristics and by disentangling the effects of these two deregulatory acts they find that while intrastate deregulation decreases the

level and risk of innovation by young, private firms, interstate deregulation increased both.

Finally, at least two more papers use a different setting than deregulation to study innovation and bank financing. First, Smith (2011) uses survey data to investigate the role of debt and bank loans in the early financing of new high-tech firms. She finds that information asymmetry combined with technical risk influences the ability to secure bank financing. In particular, there is evidence that as information asymmetry is lessened over successive periods, banks are more likely to lend to high-tech firms. As the riskiness of high-tech firms decreases, they are increasingly likely to receive bank loans over time. Nanda and Nicholas (2014) further examine the link between the health of the financial sector and innovation. Interestingly, while previous papers in this field exploit liberalizations as positive shocks to the banking credit supply, they exploit the impact of a credit squeeze, using the Great Depression as an exogenous event at the firm level. With micro-data on corporate R&D, patent and patent citation records from the U.S. patent office and county-level data on banking in the United States compiled by the FDIC, they exploit cross-county variation in the severity of bank distress to understand how this affected corporate innovation.[7] First, they find that private firms experienced declines in R&D output and patenting activity relative to publicly traded corporations. Second, when they focus only on publicly traded firms, they find that the overall effect on patenting is smaller and concentrated among firms heavily dependent on external finance. Their findings show a negative relationship between bank distress during the Great Depression and the level and quality of innovation by the firms that were most affected.

Overall, recent empirical literature on banking and innovation has shown that bank debt is an important source for the financing of innovative projects, especially for young and small firms which do not have access to equity market. These results are in line with Rajan and Zingales (2003), which argue that relationship-based systems perform

[7]The Federal Deposit Insurance Corporation (FDIC) is a United States government corporation providing deposit insurance to depositors.

better with small firms. Moreover, the literature has shown that negative shocks to the credit supply impede innovation, while positive shocks to the credit supply affect innovation by relaxing financial constraints and altering lending relationships.

III.II Venture Capital and Private Equity and innovation

Many recent papers study the relationship between venture capital firms (VCs) and innovation and private equity (leveraged buyouts, or LBOs) and innovation. I start this section by reviewing some of the main theoretical contributions in the VC field, with the aim to understand how typical VC features may foster innovation in venture-backed companies. Then, I review the empirical work on VCs and innovation and finally I review the (relatively smaller) empirical literature analysing the effect of LBOs on innovation.

Many theory papers have focused on the mechanisms that reduce agency conflicts between entrepreneurs and investors, all of them ascribable to the typical functions that VC investors perform within the VC cycle.[8] All these functions and mechanisms, which include screening, monitoring, providing advice and staging investment, act, at least indirectly, as potential innovation stimuli. Focusing on the screening function, Chan (1983) shows how intermediaries, as informed agents, increase investors' utility by inducing the entrepreneur to offer high return projects in a VC market where all investors have positive information costs.[9] A broader analysis of the relationships occurring among the Venture Capitalist, investors (limited partners) and companies is performed by Sahlman (1990). A key feature of VC investing is that usually they do not invest all the money in a given company at the same time, but they do so in different stages, with the implicit right to abandon the project. This generates the appropriate incentives for the entrepreneur, because the misuse of funds could be very costly: first, increased capital requirements invariably dilute management's equity share at an increasingly punitive rate; second, staged investment process enables VCs

[8] The VC cycle (see Gompers and Lerner (2004)), consists in fund-raising, investing, and exiting successful deals.

[9] The screening function refers to the activity of selecting companies into which VC inject money. Additional standard functions exerted by the VC are monitoring and adding value to firms.

to shut down operations completely. In addition, denying capital is also a bad signal for other investors. Beside this, Venture Capitalists can discipline managers by firing or demoting them. Although Sahlman (1990) does not provide a model, his contribution is important for the intuitions he provides on how VC features affect an entrepreneur's behaviour and his willingness to innovate. At least three papers formally model the staging of investment: Admati and Pfleiderer (1994) model the contract between the entrepreneur and the VC and show that the only contract for the VC that induces optimal continuation in all circumstances is a fixed-fraction contract, in which the VC owns the same fraction of the pay-off independent of the continuation decision, and also finances that same fraction of any future investment. This implies that outside investors will necessarily be involved in later financing stages. Bergemann and Hege (1998) provide a model of investment staging and show that long-term contracts distribute the entrepreneur's return over time in a way that maximizes the research horizon and stress that the interaction between investment and learning process and the incentives necessary to implement both processes is central to financing of R&D in general. Finally, Cornelli and Yosha (2003) show that with stage financing VC and entrepreneurs agree to inject capital over time and the Venture Capitalist retains the option to abandon the venture whenever the forward looking net present value of the project is negative. Accordingly, the threat to abandon creates incentives for the entrepreneur to maximize value and meet goals.[10]

A number of empirical studies analyse the relationship between VC and innovative activities. While many of them measure innovation with patents, some others focus on innovative products or use total factor productivity (TFP) growth as innovation proxies.[11] One of the first papers in this field is Hellmann and Puri (2002), which analyzes a sample of Silicon Valley-based firms. Some firms received VC financing while

[10] Although not directly related with innovation, Hellmann and Puri (2002) focus on how VC provide advice to the companies in their portfolio and examines the relationship between VC's and entrepreneurs from the perspective of corporate control. His model suggests that under certain circumstances a wealth constrained entrepreneur may be willing to relinquish the right to be the CEO and be replaced by a professional manager with superior management skills and this will lead ultimately to an improvement in efficiency.

[11] Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs (aggregate capital and aggregate labour) used in production (see Comin, 2006).

others did not: the authors aim to understand whether VC involvement has an impact on the development path of entrepreneurial companies. First, they find that innovative firms are more likely to be venture-backed firms than imitator companies. Second, they find that innovative venture-backed firms are faster in bringing their products to market than non venture-backed ones. Similarly, Puri and Zarutskie (2012) confirm the VC contribution to innovation by showing that a large percentage of VC investments is in companies that are developing new products but are yet without any sales.

Kortum and Lerner (2000) further scrutinize the relationship between VC and innovation focusing on US manufacturing industries. Using patents as a measure of innovation, they first find that VC is more powerful at stimulating innovation than is corporate R&D. Then, in order to exclude the possibility that the positive effect is caused by the arrival of (unobserved) technological opportunities, they show that their results are robust to the 1979 amendment to the Prudent Man Rule, a policy shift that stimulated venture capital fundraising.[12] Overall, their findings suggest that VC financing positively affects the patenting activity of young firms. Hirukawa and Ueda (2011) try to better understand this relationship: is it VC that stimulates innovation (VC-first) or is it innovation that induces VC investments (innovation first)? Using the Granger to test for causality between innovation and VC investment, they find weak support for the VC-first hypothesis by employing TFP growth as innovation measure, while they find little evidence for both the innovation-first and the VC-first hypotheses when using patents as innovation measure.[13] Similarly with Kortum and Lerner (2000), Gonzalez-Uribe (2014) finds that patent citations increase following VC financing, particularly for patents granted to other companies financed by the same VC investor.

Beside answering to some important questions, Kortum and Lerner (2000) raise an additional question which remained unanswered for a long time. In fact, until the paper by Bernstein et al. (2015) it was not clear whether the key element that potentially

[12]Prior to 1979 amendment, the Employee Retirement Income Security Act (ERISA) limited pension funds from investing substantial amounts of money into VC.

[13]The Granger causality test examines whether past realizations of a time series are useful to predict the future values of another time series.

makes VC-backed companies more innovative is how the Venture Capitalist selects the firm to invest in (selection function) or the ex post monitoring and advising activity (monitoring function). Bernstein et al. (2015) exploit the introduction of new airline routes that reduce the travel time between VCs and their existing portfolio companies as an exogenous variation in the VC involvement to disentangle these two effects. They find that the introduction of a new airline route leads to a 3.1% increase in the number of patents produced by the portfolio company and a 5.8% increase in the number of citations, suggesting indeed that the monitoring function has a positive effect on the innovation output of companies which received VC financing. Matray (2015) provides further evidence on the relation between VC and innovation. After documenting local innovation spillovers from listed firms to private firms in the same geographical area, he studies the relationship between innovation spillovers and capital availability. First, he finds that the stock of patents filed by listed firms generates non-local VC investments. Then, he analyzes whether VC availability influences the magnitude of spillovers. After instrumenting VC investments by the amount of local and state public pension funds, he shows that exogenous variations in the amount of the available VC capital significantly amplify local innovation spillovers.

Whereas many papers study the effect of VC on innovation, very few papers analyze the impact of LBO's on innovation. Two notable exceptions are Lerner et al. (2011), and Amess et al. (2016). Lerner et al. (2011) analyze a sample of 472 firms that received private equity backing with at least one successful patent application filed in the period from 3 years before to 5 years after being part of a private equity transaction. Although they do not find evidence that LBO transactions affect the level of patenting, they find that patent citations increase in the years following the transaction. While these findings are a very important contribution in the long-standing debate about whether LBOs create value for the firms they acquire, the authors acknowledge that their analysis might well suffer from endogeneity problems, i.e. they are unable to determine whether LBOs cause changes in patent activity or whether private equity firms

select among the potential targets those which already have forthcoming improvements in patent activity.[14]

The empirical strategy of Amess et al. (2016) directly addresses this issue and confirms Lerner et al. (2011)'s findings. With a sample of UK LBO transactions and by using the propensity score matching technique, Amess et al. (2016) compare in a difference-in-differences setting the innovation output of LBO backed companies with a control group of firms with similar pre-buyout characteristics, such as size, labour productivity, exporting, skill intensity, debt, profitability and age, that were not financed by LBO funds. First, they find that private equity-backed firms increase patenting output, both in terms of patents counts and in terms of patent citations. Second, they find that this effect is concentrated among firms that are likely to be more financially constrained, such as firms belonging to industries with a high dependency on external finance, firms that were privately owned before LBO investment and firms that have a relatively low credit score. Among this group of firms, those with lower creditworthiness have the largest effect on quality-adjusted patenting. This result may be explained by an interesting feature of LBOs financing: because of their relationships with banks, LBOs can get cheaper debt than target companies could obtain under their current management.

To conclude, there is consensus around the positive role of VC financing in nurturing innovation in young and small firms. Interestingly, recent empirical evidence has established the beneficial role of LBOs about one form of long-run investment, namely, investments in innovative projects. In fact, as it was the case for before Bernstein et al. (2015) in the context of VC, research had still to prove if LBOs affect the innovation output of the companies in which they invest or they select companies with stronger innovation potential. Reassuringly, Amess et al. (2016) fill this gap.

[14]Still, these findings pertain predominantly "old economy" firms, suggesting that the concern is moderate.

IV Conclusions

Recent years have seen a profusion of papers examining the relation between finance and innovation, which often build up on the literature on finance and economic growth.

This survey analyses some of the main functions exerted by financial markets and their impact on innovation. Although financial markets may exacerbate agency costs that might be detrimental to firms engaged in innovative activities, a large body of work show how they foster innovation by relaxing financing constraints, producing information, and monitoring. This survey also covers the literature analysing how financial intermediaries interact with firms and affect their innovative efforts. While there are new findings showing a positive link between bank financing and innovation, there is large evidence on the positive role exerted by LBOs and especially VCs.

As nicely written by Zingales (2015), despite the large academic literature, Society still disagrees on the positive role of finance in promoting economic growth. Since innovation is one of the major drivers of economic growth, I think it is important to understand how finance affects innovation. While academics can contribute to improving the perception of finance in the Society, policy-makers and regulators still have many challenges ahead since they can, along with other market participants, alter or lobby to change financial market and financial intermediary characteristics. China, for example, which supports state-owned enterprises (SOEs) in strategic sectors and incentivizes multinationals to transfer their R&D centres in China, could foster indigenous innovation by further implementing structural financial markets reforms and ensuring a sound legal framework.[15]

Beside China, other stock exchanges in emerging markets are still in need for reforms. Russia is a further example: in February 2013, Russia's Main Stock Exchange stocks began trading. Is this preventing Russian companies from listing abroad? And, more importantly, does the effect of the privatization of the exchange propagate to the real

[15] see The Economist, Chinese Private firms are embracing innovation, September 2015, and Cao et al.(2016), which exploits two China Securities Regulatory Commission (CSRC) implemented reforms of the IPO auction bidding process to determine the relationship between bidding dispersion and share offer pricing.

economy? Promoting innovation in young, start-up firms is also a frequent discussion topic. In this context, Hellman (2016) raises an important question for governments willing to foster entrepreneurial ecosystems: shall governments focus on policies that back entrepreneurs by helping them start companies or on policies that back investors by making investments more attractive? His theory finds that policies that back investors by making investments more attractive drive up valuations of start-ups, and thereby increase funding for future entrepreneurs.

In addition, other innovation-related topics shall be carefully considered by governments, as for example the role played by Non-Practicing Entities (NPEs), or "patent trolls", an issue particularly severe in the US.[16] I think that a better understanding of these topics should be put on the agenda for future research.

[16]See Cohen, Gurun, Kominers, 2015 for a theoretical model and empirical evidence of the behaviour and impact of NPEs in the US

Chapter 2

The Big Innovation Bang

Ostinelli, D., The Big Innovation Bang, Working Paper, 2016.

I Introduction

Does stock market development promote innovation? While innovation has been recognized as being pivotal for economic growth (Solow (1957)) and the relationship between economic growth and broad financial development has been extensively investigated, as reported in the survey by Levine (2005), there is little empirical research directly relating innovation and financial markets development. Whereas theoretical predictions about the role of stock market development on innovation are mixed, the difficulty when studying empirically the effect of financial development on innovation is that innovation may be endogenous with company and financial market conditions, including stock market characteristics.

To overcome this obstacle, I employ a quasi-experimental design that allows me to examine the reaction of firms to a significant act of financial markets deregulation. In particular, my identification strategy consists in exploiting the London Big Bang, a package of reforms swept through the London Stock Exchange on October 1986, as a quasi-natural experiment for a plausibly exogenous shock to stock market development. The London Big Bang has been the most rapid and complete regulatory reform of any market: the exclusion of all foreigners from Stock Exchange membership was terminated, fixed trade commissions were abolished and trading moved off the floor.[1]As a consequence of the Big Bang, foreign banks acquired UK brokers and jobbers, trading volume increased, transaction costs decreased and eventually the City of London consolidated its position as one of the major players in the international financial markets.

Whereas the Big Bang affected all the spectrum of firms listed in London, I expect that the effect of an improvement of stock market development on corporate decisions with regard to innovative projects varies along firm's dependence on external finance, as suggested by the financial development literature. For example, Rajan and Zingales (1998) show that stock market development fosters economic growth in more external finance dependent sectors. In fact, the fundamental role of financial markets in lessening

[1]Brokers buy and sell shares on behalf of their clients while jobbers (or dealers), as the specialists in the US, act as the market maker on a given security.

the moral hazard and adverse selection problems should reduce the cost of external finance *vis à vis* the cost of internal capital. With this in mind, while firms with strong balance sheet may finance innovative projects internally, for more financially constrained firms it becomes even more critical to finance investment projects raising money from outsiders. As a consequence, firms more dependent on external finance should be better off with more developed financial markets and should benefit the most from an improvement in its development.

Using hand-collected data, I first show in a difference-in-differences (DiD) setting that British listed firms belonging to industries that are more external finance dependent innovate more after the Big Bang than low external finance dependent firms. Then, with the aim to address the concern that my results are driven only by unobserved technological trends at industry level, I compare the innovation output of listed UK firms with a group of listed Dutch and Italian firms unaffected by the shock. Both the Netherlands and Italy seem an appropriate control group for the following reasons: first, the Netherlands export extensively to the United Kingdom. Therefore, British and Dutch firms are exposed to similar macroeconomic conditions, yet their financing opportunities differ. Second, Italy reformed its Stock Exchange only in the Nineties: as a consequence, Italian firms were not in a position to benefit from well developed stock market at the time that the London Big Bang happened. Reassuringly, they do not exhibit the same post-Big Bang pattern. Finally, I show that there is no pre-deregulation trend.

Second, I further support my results by borrowing the Hsu et al. (2014) mapping strategy and analyzing innovation at industry level. Consistent with my methodology, I show that patenting activity of more external finance dependent industries increased following the deregulation. I conduct a number of robustness checks to examine whether my results are robust to alternative proxies for external finance dependence, and are particularly significant for manufacturing industries, since patents are more important to manufacturing industries than to other industries. As for the firm level analysis, I

show that there is no trend before the London Big Bang.

Finally, I explore the possible mechanisms through which improved stock market conditions promote innovation. In particular, I use the DiD approach to inquire if changes in the potential mechanism are more significant for high external finance dependent firms than for low external finance dependent firms. First, I find that the interaction term for equity financing is not statistically different from zero, suggesting that both groups increase their reliance on equity financing following the Big Bang. Second, I find that firms belonging to more external finance dependent industries decrease their long term loans issue. Therefore, a different source of financing resulting in less recourse to debt could ease the funding of innovative projects for firms belonging to more external finance dependent industries.

My research question relates to a large body of theoretical works linking financial markets and economic growth. While some papers focus on the myopic corporate behaviour which potentially harms good investment opportunities, other research predicts a positive effect of financial market development on innovation.[2] First, financial markets are essential in fostering specialization, as captured in the model of Greenwood and Smith (1997). Since more specialization requires more transactions and transactions are costly, financial arrangements that lower transaction costs will facilitate greater specialization. A second and perhaps even more important function of financial markets is to produce information about possible investments and allocate capital. Since acquiring information is costly, investors may not have the ability to gather information before making investment decisions. Financial intermediaries may therefore reduce the cost of acquiring information ex ante, with a subsequent improvement in capital allocation. The model of Greenwood and Jovanovic (1989) shows that, assuming that many entrepreneurs need capital and that capital is scarce, financial intermediaries that produce better information on firms will thereby fund more promising firms and induce a more efficient capital allocation.

[2]See Holmstrom (1989) and Stein (1989) for the managerial myopic behaviour. Managers facing a rational stock market may abandon good investments at the expense of longer terms benefits.

My findings contribute to two streams of literature. First, my paper contributes to the literature that examines the outcomes of financial markets regulation, with focus on the United Kingdom. Chambers and Dimson (2009) analyze historical underpricing on the London Stock Exchange and find that in the post Big Bang period underpricing has continued to rise, and while it has been driven by substantial underpricing of smaller firms, IPOs on the main market have also displayed higher underpricing. Gemmill (1996) analyzes the effect of three different prices publication regimes of block trades after the Big Bang and finds that reducing transparency by delaying the publication has little impact on spreads, speed of adjustment, smoothing, or ultimate price level. Braggion and Ongena (2015) investigate firm-bank relationships and corporate financing during a 90-year period from 1896 to 1986 in Britain and find that following the banking sector deregulation in 1970 firms shifted from bilateral to multilateral relationship banking. Moreover, they provide evidence that after the deregulation firms that added banks increased their reliance on bank debt and leverage. I continue this line of inquiry by showing that the Big Bang, which entailed major restructuring of most aspects of London's securities trading, had an impact beyond the financial industry and affected corporate innovation output.

Second, I contribute to the literature on finance and innovation.[3] This literature focuses on relations between innovation and firm characteristics and on relations between innovation and financial market characteristics. With regards to innovation and firms characteristics, Seru (2014) attests the importance of firm boundaries on innovation, while Fang et al. (2014) find that stock liquidity deters innovation. Aghion et al. (2013) show that firms with higher institutional ownership innovate more as higher institutional ownership lowers manager career concerns that arise with riskier innovation. Bernstein (2015) finds that going public significantly reduces firms' innovation quality and that public firms partially offset their lower internal innovation output with respect to private firms with externally purchased innovation by M&A. By contrast there

[3]For a comprehensive review of the recent literature on the financing of innovation see Kerr and Nanda (2014) and Ostinelli (2016b).

are few empirical studies analyzing the link between innovation and financial market characteristics. Benfratello et al. (2008) find that local banking development increases the process innovation of Italian manufacturing firms, while Nanda and Nicholas (2014) show that bank distress during the great depression diminished both the quantity and the quality of firm patenting. Cornaggia et al. (2015) provide evidence that increasing banking competition fosters innovation among corporations that are heavily dependent on external finance. My research is also closely related with a recent study focusing on the relationship between innovation and financial markets development. Building on the seminal work by Rajan and Zingales (1998), Hsu et al. (2014) find that more external finance dependent industries exhibit a disproportionally higher innovation level in countries with better developed equity markets, while the development of credit markets appears to discourage innovation in industries with these characteristics. My contribution is to study the innovation output with firm level data and to exploit a different identification strategy allowing me to investigate a potential mechanism for how an improvement in stock market development fosters innovation.

The rest of the paper is organized as follows. Section II describes in more detail the changes that took place at the London Stock Exchange in 1986. Section III discuss my data collection and provides summary statistics. Section IV describes my empirical strategy and reports my results. Section V concludes.

II The 1986 London Big Bang

The London Big Bank, which occured on October 27 1986, represented a dramatic change for the London Stock Exchange. Before discussing the principal aspects of the reform and its effects, I start with a historical perspective of the main characteristics of the London Stock Exchange prior to the deregulation.[4]

[4]See Kerr (1986), Plender (1986) and Clemons and Weber (1989) for a more detailed description

II.I London's market prior to the 1986 deregulation

In the early eighties the London Stock Exchange was a walking anachronism.[5] The Exchange was dominated by a few members, was highly regulated and securities were exchanged on the trading floor. Firms could participate to the London Stock Exchange either as *brokers* or as *jobbers*. The broker acted on behalf of his client wishing to buy or sell shares, while the jobber had a position on a given stock or bond and would buy from brokers with clients who wanted to sell and sell from brokers with clients who wanted to buy. Moreover, membership restrictions hindered competition: just three major jobbers, Smith Brothers, Wedd Durlacher Mordaunt and Akroyd & Smithers had a market share of 75% and along with a handful of brokers they controlled the market in London. Not only were there few banks operating on the Exchange, but the Exchange practices themselves implied high costs when trading securities. Each transaction was taxed with a 1% stamp duty and included two brokers, who took a fixed commission, and the jobber, who took the spread, the difference between his buying and his selling price.[6] As a matter of comparison the NYSE, as well as the other US stock exchanges, abandoned fixed commissions on shares transactions in 1975.

Already in 1979, shortly before Margaret Thatcher took office as prime minister, the Office of Fair Trading launched an investigation into the restrictive practices of the London Stock Exchange, in particular the system of fixed minimum commissions, which resulted in a court proceeding against the Exchange in October 1979.[7] Beside the Office of Fair Trading, the situation also worried the Bank of England, which was among the promoters of deregulation. First, since its statutory obligation was to raise money for the government on the cheapest possible terms, the Bank of England wanted the Stock Exchange to provide a suitable Gilts market-place.[8] Moreover, even after the nationalization of 1946, the Bank of England continued to act as an informal trade association for the promotion of City interests, and managed to persuade officials and

[5] See Kerr (1986)

[6] The stamp duty is a tax on share transactions of UK incorporated companies

[7] The Office of Fair Trading, established by the Fair Trading Act 1973 and closed on April 2014, was a non-ministerial government department of the United Kingdom responsible for protecting consumer interests

[8] Gilts are British Government Bonds, traded through the Stock Exchange

ministers that the City's earnings were important and that there was an opportunity both to preserve and to increase jobs in an important part of the service sector of the economy.

Another argument in favor of the change was the competitive pressure, exerted in particular from the American and the Japanese stock exchanges. As highlighted by many practitioners, an Exchange needs to be efficient and attractive.[9] Still, the fixed-minimum broking commissions, the margin between buying and selling prices demanded by the very few jobbers and the stamp duty of 1% imposed by the British government, all ensured that London was an expensive place to trade securities. After many discussions and facing fierce opposition, especially from existing exchange members reluctant to abandon fixed commissions, the Secretary of State for Trade and Industry Cecil Parkinson and the Chairman of the London Stock Exchange Sir Nicholas Goodison reached an agreement in the summer of 1983, which resulted in the withdrawal of the case brought against the London Stock exchange by the General Director of Fair Trading, with a little more than a three years time table leading towards regulation.

II.II The 1986 deregulation and its consequences

The London Stock Exchange deregulation, known as Big Bang, was part of the 1986 Financial Services Act, passed by Margaret Thatcher during her second government to regulate the financial services industry. The 1986 deregulation affected many aspects of the exchange, which was previously run as a kind of private club, and changed the face of the UK securities market almost behind recognition.[10]

First, fixed trade commissions were eliminated, with rates de facto open for negotiations, and stamp duty was cut to 0.5% from 1%.[11] Second, the separation between jobbers and brokers was abolished and the ban for foreign banks to become member of the exchange was lifted. With the elimination of the prohibition against performing

[9] See Clemons and Weber (1989).

[10] Sir Kenneth Berrill, former Chairman of the Securities and Investments Board (SIB). The Securities and Investments Board (SIB), later renamed Financial Services Authority (FSA), was the agency responsible for the regulation of the financial services industry in the United Kingdom.

[11] See Bond et al. (2005).

both functions, most firms chose to operate in dual-capacity, with broker-dealer services and market making operated within a single firm. Even before the Big Bang a number of acquisitions and mergers took place, with a striking change in the nature and the number of participants: following the Big Bang nearly 200 players were active, including major foreign banks. UK retail banks, meanwhile, were free to set up integrated investment banking operations for the first time: for example, Barclays adopted a one-bank strategy in 1985 and expanded into merchant banking activities with the purchase of stock-trading companies de Zoete and Wedd (later Barclays de Zoete Wedd) and into market-making and stock-brokering.

The role of technology was also pivotal for promoting the London Stock Exchange after deregulation, with hundreds of millions of pounds invested in communication systems and the introduction of SEAQ (Stock Exchange Automation Quotation System), based on NASDAQ. Whereas Stock Exchange members fiercely competed before the Big Bang to have the best place on the trading floor, screen-based trading, which at the beginning was conceived only as an alternative to the floor, became rapidly superior. The design of the so-called upstairs dealing rooms and the different mechanism of telephone trading made possible better interaction between different bank divisions and between banks and investors compared to the floor.

Another aspect frequently neglected in the Big Bang chronicles has been the introduction of an additional flotation method. Prior to the reform, rights offerings was the only method of issuing seasoned equity in the UK. With rights offering, current shareholders only are allowed to purchase shares pro rata (proportionate to their existing ownership position) at a specified exercise price until a designated expiration date. On the contrary, following the Big Bang UK firms were able also to conduct placings. With placing, non current shareholders can buy newly issued shares, with investment banks usually underwriting the offer.

The Big Bang had almost immediate effects on the London stock exchange, including increased trading volume, reduced spreads and increased trading of foreign securities.

According to a report of the International Stock Exchange[12], while commissions for small trades rose slightly, institutional rates fell more than 30% and half of the equity turnover was done net, with no commissions at all. Therefore, along with a reduction in transaction costs, it seems reasonable to deduce that the London Big Bang provided the stock market in London with a totally new impetus and a joint combination of an increased amount of information producers and improved interaction between banks and their clients ultimately decreased the information asymmetry between firms and investors. As highlighted by Clemons and Weber (1989), the London Big Bang has been the most rapid and complete regulatory reform of any market, and the most striking example of a regulatory event engineered to benefit the local financial industry. Moreover, the London Big Bang likely was not been conceived to foster innovation in the United Kingdom. For all these reasons, the Big Bang arguably represents an exogenous shock to stock market characteristics, and seems well suited to analyze the effect of financial development on innovation.

III Data, variable measurement and summary statistics

III.I Sample selection

I construct my hand-collected data set from various databases. I collect corporation-year patents and citations from the last version of the National Bureau of Economic Research (NBER) Patent Database and company financial information from Thomson Reuters Datastream and DTI-Cambridge during the period from 1981 to 1992. I focus the main part of my analysis on patents filed in the US by British individuals or non-government institutions in manufacturing industries, because patents play a more pivotal role in manufacturing industries than in other industries.

One challenge that immediately arises when analyzing patents filed in the US by foreign firms is that, unlike for US firms, there is not a unique firm identifier and firms are not linked to Compustat. Moreover, firms may register patents with different

[12]The International Stock Exchange (ISE) was the former name of the London Stock Exchange

company names or through different subsidiaries, and in this case the Patent Office assigns to each patent a different firm identifier code. The sampling methodology I utilize to build up manually my database can be illustrated with a simple example. Avon Rubber, a global leader in tyre design and production, has been listed on the London Stock Exchange since 1933. In order to try to consider all the patents filed by Avon Rubber from 1981 to 1992, I search not only patents filed by an entity with the name "Avon Rubber", but also by entities with a similar name, including potential typographical errors. In 1981, I find in the patent database a patent filed by "Avon Inflatables LTD". In order to decide whether I shall insert it in my sample, I screen the available public information (firm web site and Google) to understand if Avon Inflatables LTD is related to the listed company Avon Rubber. First, I find in Google that Avon Inflatables Ltd is a manufacturer of inflatable boats and belonged to Avon Rubber until 1994. I further check on Avon Rubber website and find that in fact the listed company Avon Rubber started in 1959 the production on a range of inflatable boats. Therefore, I include this patent on my sample. I keep on this procedure for the following years and include patents filed by entities with the name "Avon Ind Polymers LTD", "Avon Rubber CO LTD", and "Avon Rubber PC". Still, I do not include a patent filed by "Avon Murdock LTD", which is a patent registered by the inventor George Murdoch and is not related by any means to Avon Rubber. Additionally I also count patent citations, which are a measure of innovation quality.

The sample selection procedure results in a panel containing 41 British firms listed on the London Stock Exchange which I observe for 12 years. In order to address the concern that my results are driven by unobserved industry level trends, I collect a sample of 34 Dutch firms and 28 Italian firms which I also observe for 12 years. In fact, if a technological shock happened simultaneously with the London Big Bang in industries that are more external finance dependent, then the observed increase in patenting activity could be driven by an unobserved shock and not by the London Big Bang itself. While the United Kingdom and the Netherlands have historical and geographical ties,

Italy reformed its Stock Exchange considerably later.[13]For these reasons, they both seems a well suited control group to address this concern.[14]

In my industry level analysis I assign patents to industries instead of assigning patents to firms and eventually firms to industries as I do in my firm level analysis described above. Since the United States Patent and Trademark Office (USPTO) assigns patents to three-digit technology classes, I follow the Hsu et al. (2014) mapping strategy for the conversion from three-digit technology classes to the SIC final product classification. I convert patents or citations by multiplying the number of patents or citations assigned to firms belonging to a given three-digit technology to its correspondent weight. For example, if out of hundred patents of the USPTO class 1 seventy of them belong to firms of the SIC class 35 and thirty of them belong to firms of the SIC class 36, then the corresponding weights are 0.7 for SIC class 35 and 0.3 for the SIC class 36. Therefore, a patent in a given year belonging to the USPTO class 1 will count as 0.7 patent for the SIC class 35 and 0.3 patent for the SIC class 36. An implicit assumption of this method is that public firms' patent class distribution in the UK is equal to public firms' patent class distribution in the US. The same assumption, namely that public firms' patent class distribution is constant over countries, has been made by Hsu et al. (2014) and seems reasonable for my purposes. This procedure has the following advantage: whereas my manually built database allows me to track innovation activity at firm level, it may miss subsidiaries bearing a very different and unrelated name from the parent company. Therefore, by following this mapping strategy I can address the concern that my results are driven by my classification.

[13]The reorganization of the Italian Stock Exchange, with exchange agents losing their monopoly for stock exchange contracting and the introduction of electronic trading, took place in 1991.

[14]France reformed its Stock Exchange in 1987 with the so-called "Le Petit Bang", when foreign banks, brokerage houses and French financial institutions were allowed to buy equity in French stockbrokers. Germany introduced a computer-based price information system in 1987 and launched the DAX index in 1988.

III.II Variables measurement

Measuring innovation

While it has been common practice in the finance literature to use both R&D expenditures and patents as a proxy for firm innovation activity, my observation period forces me to use patent-based metrics only, since in the UK only in 1989 a new accounting standard, SSAP 13, required UK firms to disclose R&D expenditures.[15] Still, although previous works show that only a fraction of innovative firms use the patent system, Trajtenberg (1990) and Griliches et al. (1986) show that widely accepted patent-based metrics better measure research productivity than R&D investments, and they have been used in many previous studies.[16] Furthermore, whereas my observation period precludes using R&D expenditures, it alleviates the concern that a firm could strategically decide not patenting an inventive idea in order to maintain an invention secret. As highlighted in a recent survey paper by Hall et al. (2014), a firm may face the patent-secrecy trade-off. This trade-off was already present in the 80's, but the America Inventor's Protection Act (AIPA) of 1999 further reduced the attractiveness of patenting versus the use of secrecy. In fact, after the AIPA's introduction, firms were forced to disclose information about their patent applications within 18 months after the filing date, while prior to AIPA only information regarding eventually granted patents were disclosed.[17]

Following the procedure described before, I construct my two proxies of firm innovation from the last version of the NBER Patent Database, initially created by Hall et al. (2005). The database contains detailed information on patents granted by the USPTO from 1976 to 2006; for each patent granted, information is available on patent assignee name, year of application, year of grant and the number of citations received, while unsuccessful applications are not recorded. An appealing feature of USPTO data

[15] see Hall and Lerner (2010).

[16] see Hall et al. (2013) for an investigation in the UK and Balasubramanian and Sivadasan (2011) for US manufacturing firms, and Seru (2014).

[17] Saidi and Zaldokas (2016) exploit the AIPA as an exogenous shock to firms' public-information disclosure and show that firms in industries that were affected more heavily by this legal change (i.e. industries with a big lag between patent applications and grant dates) were significantly more likely to switch bank.

is that they include patents from non-US based companies. Given the pivotal role of the U.S. economy, I assume that all important inventions from UK companies have been patented in the U.S.. In particular, my approach follows the spirit of Acharya and Subramanian (2009): when they analyze the effect of national bankruptcy codes on innovation, they implicitly assume that their firms are affected by country conditions in terms of financing while they register their patents in the US.

Based on these information, I construct my first measure of firm annual innovation output $Pat_{i,t}$ by aggregating the number of patent applications filed in a year by a given firm six years before and six years after the deregulation. A concern for counting patents granted as a proxy for innovation is that this measure, although intuitive, does not differentiate between ground-breaking inventions and incremental technological discoveries. I construct my second innovation measure $Cit_{i,t}$, by aggregating the number of forward patents citing the patents of a given firm. As suggested in prior studies (e.g., Trajtenberg (1990); Harhoff et al. (1999); Aghion et al. (2013)), patent citations better capture the invention's influence and may better assess innovation quality and its market value.

Analogously, I construct my industry level innovation measures $Pat_{j,t}$ and $Cit_{j,t}$ by aggregating the number of applications filed and the number of citations in two digit industry j, that are eventually granted to firms of a given industry. In accordance with Griliches et al. (1986), I also calculate annual patent counts based on each patent's application year instead of its grant year, as the application year better captures the actual effective time of innovation. Moreover, I exclude patents filed by the UK government because its patents are less likely driven by financial market development (Bravo-Biosca (2007)).

Measuring external finance dependence

I use first the Rajan and Zingales (1998) measure to categorize firms and industries in my data set as being more, or less, dependent on external finance. The underlying idea is that a firm or an industry with a high external finance dependence measure uses

more external finance to fund its investment, both in fixed and intangible assets. In the spirit of Rajan and Zingales (1998) I assume that capital markets in the United States are relatively frictionless, and therefore the United States are the best market to determine an industry's technological demand for external financing. If a firm is active in more than one sector, as for example the British confectionery company Cadbury, I take the average of the two sector measures to which it belongs, following the International Standard Industrial Classification (ISIC) used in Rajan and Zingales (1998). For instance, Cadbury measure of external finance would be the average of the *311, Food products* sector and the *313, Beverages* sector.

Then I construct a dummy variable, Dep_j, which equals one for firms above the firms' median external finance dependence and zero for firms below the firms' median external finance dependence. The Rajan and Zingales (1998) external finance dependence measure pertains to firms from the 1980s in the US, and by applying it to UK firms I therefore assume persistence across country, namely that firms belonging to the same sector in the UK and in the US have the same need of external finance. Since firms could alter their measure of external finance (for example by hiring more engineers, which has a direct impact on firm's cash flows), I believe that for endogeneity reasons the US measure is better suited to my analysis. Still, I also use in robustness tests an external finance dependence measure based on British firms, $DepUK_j$, and the Rajan and Zingales (1998) dependence on external equity measure, $DepEQ_j$. The external finance dependence measure based on British firms is defined as the ratio of Capital Expenditures minus Free Cash Flow from Operations over Capital Expenditures. Since the DTI Cambridge Database, which contains comprehensive financial information on British Manufacturing firms, does not report Capital Expenditures, I use Datastream instead. First, I calculate free cash flow from operations as funds from operations plus decreases in inventories, decreases in receivables, and increases in payables. Then I calculate each firm's dependence on external finance, $FirmDepUK_{j,t}$, as capital expenditures minus free cash flow from operations, all divided by capital expenditures.

Then I take for each observation year the median of the firms belonging to a given industry. Finally I obtain my industry's dependence on external finance, $DepUK_j$ as the median of my yearly industry observations. The measure of dependence on external equity $DepEQ_j$ that I borrow from Rajan and Zingales (1998) is calculated as the ratio of the net amount of equity issues to capital expenditures.

III.III Summary statistics

—Insert Table 1 about here—

Table 1 shows the summary statistics of my firm level analysis. British high external finance dependent firms increase their innovation output after the London Big Bang, while low external finance dependent firms do not increase their innovation output. On the contrary, Italian firms show constant innovation output, both in terms of number of patents and number of citations, while the increase in the number of citations of Dutch firms is common to high and low external finance dependent firms.

—Insert Table 2 about here—

Table 2 reports the summary statistics of my innovation measures and external finance dependence from 1984 to 1989 across the twenty SIC industries that I consider in my industry level analysis. Patenting-prone industries such as Chemicals and Allied Products (SIC 28), Electronic and other Electrical Equipment and Components (SIC 36), and Industrial and Commercial Machinery and Computer Equipment (SIC 35) exhibit high level of innovation both in terms of patents and citations: they produce on average 406 patents, 327 patents, and 300 patents per year with 3141, 2908 and 2690 citations respectively.

IV Empirical analysis

IV.I Firm level analysis

In this section I present my main results and discuss the main findings.

One of the biggest challenges of my research question is to establish a causal effect between financial development and innovation. In order to address this issue, I exploit the 1986 London Big Bang as a large and exogenous shock to stock market development. My identification strategy consists in isolating the Big Bang effects on firm behaviour by studying differential post reform changes across different industries in the United Kingdom. According to their growth prospects, firms have different need of external finance and therefore I expect their reaction to the Big Bang to be different. I use the Rajan and Zingales (1998) measure of external finance dependence to categorize firms as being more or less dependent on external finance. In fact, firms highly dependent on external finance should benefit more from the Big Bang, in terms of innovation, compared to firms that rely more on internal cash flows to finance innovative projects.

The first equation I run at firm level is:

$$Innovation_{i,t} = \alpha_1 + \beta_1 * Dep_j * BigBang_t + \delta * X_{i,t} + \mu_i + \gamma_t + e_{i,t} \tag{2.1}$$

$Innovation_{i,t}$ is one of my two measures of innovation output, namely the number of patent $Pats_{i,t}$ and the number of citations $Cits_{i,t}$. $BigBang_t$ is a dummy that equals one if an observation is of 1987 onwards and zero otherwise, Dep_j is a dummy that equals one if a firm belongs to an industry with high external finance dependence measure and 0 otherwise, $X_{i,t}$ is a vector of control variables, μ_i are firm or industry fixed effects and γ_t are year fixed effects.

—Insert Figure 1 about here—

In Figure 1, I plot the timeline of my identification strategy. In order to deal with a potential endogeneity issue, in the spirit of Rajan and Zingales (1998) I consider the US as the most highly developed and liberal financial market in the world in which firms are likely to face the least constraints to raising equity finance. I borrow their measure of external finance dependence, calculated as capital expenditures minus cash flow from operations divided by capital expenditures.

—Insert Table 3 about here—

Table 3 reports the effect of the London Big Bang on the British sample at firm level, with $Pats_{i,t}$ as dependent variable in Panel A and $Cits_{i,t}$ in Panel B. When I interpret the regression results, I focus on the sign and significance level of the interaction effect β_1. Since my dependent variables $Innovation_{i,t}$ may be auto-correlated over time, in order to avoid inflated t-statistics I follow Petersen (2009). In particular, I cluster standard errors by firm when using firm fixed effects (column 1) and by industry when using industry fixed effects (column 2). In column (3), I add firm's fixed assets as a control variable. In all these three specifications coefficient estimates of β_1 are positive and significative. In specification (1) their estimates are 6.11 for patent counts and 34.15 for citation counts respectively. These results show that patenting activity of firms belonging to more external finance dependent industries is increasing after the Big Bang, consistent with theory predictions suggesting that an improvement in stock market development promotes economic growth in sectors that are more dependent on external finance. In unreported regressions I run equation (1) with a discrete measure of external finance dependence and find similar results.

In order to mitigate the concern that industry trends only lead my results, I extend my analysis by including listed Dutch and Italian manufacturing firms. The second equation I run at firm level is:

$$\begin{aligned} Innovation_{i,t} = \alpha_1 + \beta_1 * Country_i * BigBang_t + \beta_2 * BigBang_t * Dep_j \\ +\beta_3 * Country_i * BigBang_t * Dep_j + \mu_i + \gamma_t + e_{i,t} \end{aligned} \tag{2.2}$$

In this specification I add the term $Country_i$, which takes the value of 1 if a firm is from the UK and 0 otherwise. The coefficient of interest β_3 is the interaction term between the Big Bang, the UK and the external finance dependence measure.

—Insert Table 4 about here—

Table 4 reports the regression results: coefficient estimates of β_4 are positive and significative. This suggests that high external finance dependent firms benefit from the

Big Bang in terms of innovation in the UK only, which mitigates the concern that an unobserved technological trend at industry level drives my results.

—Insert Table 5 about here—

In Table 5 I test the parallel trends assumption and find that the coefficient of interest is not significantly different from zero.

IV.II Industry level analysis

Main results

In this section I present and discuss my findings of the industry level analysis.

My baseline equation is:

$$Innovation_{j,t} = \alpha_1 + \beta_1 * BigBang_t + \beta_2 * Dep_j + \beta_3 * Dep_j * BigBang_t + e_{j,t} \quad (2.3)$$

The dependent variable $Innovation_{j,t}$ is one of my two measures of the innovation output, namely $Pats_{j,t}$ or $Cits_{j,t}$. The measure $Pats_{j,t}$ counts the number of successful patents applications per industry in a given year, while the measure $Cits_{j,t}$ does the same for the number of non-self-citations. Unlike the firm level analysis, in the industry level analysis I use the Hsu et al. (2014) mapping strategy and assign patents directly to industries. $BigBang_t$ is a dummy that equals one if an industry-year observation is from a year after the Big Bang and zero otherwise. The external finance dependence measure, Dep_j, is the measure of external finance dependence for industry j over the observation period and equals one if an industry is high external finance dependent and 0 otherwise. In order to deal with a potential endogeneity issue, I borrow the Rajan and Zingales (1998) measure of external finance dependence. The interaction term $Dep_j * BigBang_t$ captures the post-differential effect of the Big Bang.

—Insert Table 6 about here—

Table 6 reports the effect of the London Big Bang on industry innovation output. When I interpret the regression results, I focus on the sign and significance level of

the interaction effect β_3. If it is positive and significant, it shows that stock market development exerts a disproportionately positive effect on industries that are highly dependent on external finance. In row (1), I run the regression with $Pats_{j,t}$ as dependent variable. The coefficient estimate of the interaction term β_3 is 19.37. Since it is positive and economically and statistically significant, it suggests that industries more external finance dependent benefit from a development of the stock market conditions. In row (2), I run the same regression with $Cits_{t,j}$ as dependent variable in order to examine the effects of financial market development on innovation quality. The coefficient β_3 on the interaction effect is positive and economically and statistically significant. Its estimate is 156.62; therefore, industries more external finance dependent benefit from a development of the stock market conditions also in terms of innovation quality. I show evidence also in my industry analysis that stock market development promotes innovation in industries that are more dependent on external finance. Therefore, I alleviate the concern that my results at firm level are driven by my manual classification.

Further analysis

In this section I run regression (3) with two alternative measures of external finance dependence. I use first the Rajan and Zingales (1998) dependence on external equity measure, $DepEQ_j$, calculated as the ratio of the net amount of equity issues to capital expenditures. Second, I use an external finance dependence measure calculated with listed British firms financial data, namely $DepUK_j$.

—Insert Table 7 about here—

Table 7 reports the results of running equation (3) with these two alternative external finance dependence measures. The results are consistent with what I obtained with the previous measure Dep_j, and confirm that the London Big Bang has been particularly beneficial to firms belonging to high external financial industries.

—Insert Table 8 about here—

In table 8 I extend my sample to all the industries of the SIC spectrum (from SIC 1 to SIC 99). With a difference in DiD, I run the following equation:

$$\begin{aligned} Innovation_{j,t} = \alpha_1 + \beta_1 * BigBang_t + \beta_2 * Dep_j + \beta_3 * Manufacturing_j \\ +\beta_4 * Dep_j * BB_t + \beta_5 * Dep_j * Manufacturing_j \\ +\beta_6 * BB_t * Manufacturing_j + \beta_7 * BB_t * Manufacturing_j * Dep_j + e_{j,t} \end{aligned} \tag{2.4}$$

Coefficient estimates of β_7 , the triple interaction term between the Big Bang, the external finance dependence measure and Manufacturing are positive and significative, showing that the Big Bang has been particularly beneficial to manufacturing industries.

—Insert Table 9 about here—

In table 9 I run a test to address a crucial assumption in difference-in-differences regressions, namely, that of parallel trends. By dividing the sample in two (high external finance dependence industries and low external finance dependence industries), I find that coefficient estimates of $EarlyBigBang_t * Dep_j$, which is a dummy variable that equals one if the year is within four years prior to the London Big Bang and the industry belongs to the high external finance dependence subsample, is insignificantly different from zero. Finally, I run equation (3) with industry and time fixed effects and with a discrete external finance dependence variable and find similar results (unreported).

IV.III Mechanism

In this section I examine a possible mechanism through which an improvement in stock market development reducing the cost of external funds could foster innovation in more external finance dependent firms.

Along with a substantial increase in trading volume, British firms gained the flexibility to conduct placing, while before the stock market reform rights offerings were the only method of issuing seasoned equity. While theoretical models back up this argument, just after the London Big Bang many practitioners were confident that larger UK companies would be able to raise high sums of fresh capital with greater

ease and efficiency.[18]. As a first possible mechanism, I investigate in the DiD framework how firms react to the Big Bang in terms of their reliance on equity financing. Thomson Reuters Datastream provides the number of shares outstanding, while the DTI-Cambridge database provides the number of new ordinary and preferred shares issued during a given year, which I use to calculate a proxy of Seasoned Equity Offerings proceeds.

—Insert Table 10 about here—

Results are reported in Table 10: in row (1), the dependent variable is the number of shares outstanding, namely $Shares_{i,t}$. The interaction term between the Big Bang and the external finance dependence measure is not significant. In row (2) I use my proxy of Seasoned Equity Offerings ($SEO_{i,t}$), which I obtain by multiplying the sum of the number of new preferred and ordinary shares issued during a year by the average of the stock price at the beginning of the year and the stock price at the end of the year. Also in this case the interaction term in the DiD setting is not significant. Therefore, whereas both groups of firms increase the number of shares outstanding and their SEO's proceeds after the Big Bang (run in an unreported regression), there is not direct evidence that firms more dependent on external finance increase equity more than firms less dependent on external finance.

Next, I study the issue of long term loans, which are provided on annual basis by the DTI-Cambridge Database. In row (3) I run the same regression with $LoansIssue_{i,t}$ as dependent variable while in row (4) I scale it by the total fixed assets of the previous year. The DiD estimator on loans issue is negative and economically and statistically significant in both equations. This suggest that firms belonging to more external finance dependent industries decrease their loans issue or even repay their outstanding loans after the London Big Bang. Moreover, British firms, including those more dependent on external finance, increase their equity after the Big Bang. These findings are consistent with the theoretical arguments on the role of equity and debt in financing innovative

[18]see Ian Kerr, Head of international fixed income research and advisory group at Kidder, Peabody International Limited, a securities firm. For the theory model, see Greenwood and Jovanovic (1989)

projects. For instance, Allen and Gale (1999) show that market financed projects are characterized by higher diversity of opinion than bank financed projects.

V Conclusions

In this paper I investigate the effect of an improvement of stock market development on corporate innovation. The innovation process, due to its intrinsic nature, has uncertain results and high probability of failure. In this paper I provide evidence that better developed stock markets not only could be beneficial for the local financial services industry, but also be helpful for promoting innovation. My identification strategy uses the 1986 London Big Bang as an exogenous shock to stock market development. The London Big Bang provided the London Stock Exchange with a totally new impetus and broke up many of the customs and practices prevailing in the City of London. In particular, it resulted in the deregulation of fixed brokerage commissions, the termination of restrictions on the Exchange membership and the consequent admission of foreign firms. Moreover, the introduction of electronic trading rapidly replaced the old-fashioned trading floor.

While it is widely known that the London Big Bang played a pivotal role in promoting London as a leading financial centre, I provide evidence of its beneficial role to the real economy in the UK with regards to innovation. With a DiD setting, I compare the innovation output of firms belonging to high external finance dependent industries to a control sample of firms belonging to low external finance dependent industries. Consistent with the literature on financial development, I show that firms belonging to more external finance dependent industries increase their innovation output after the London Big Bang. In addition, the same effect on innovation is not present for a sample of non-British listed firms unaffected by the deregulation. Finally I inspect a potential mechanism that could contribute to these findings: firms belonging to high external finance dependent industries increase their equity and, in addition, decrease their loan financing after the deregulation significatively more than firms belonging

to low external finance dependent industries. Thus, equity financing instead of debt financing could result in higher innovation levels for these firms.

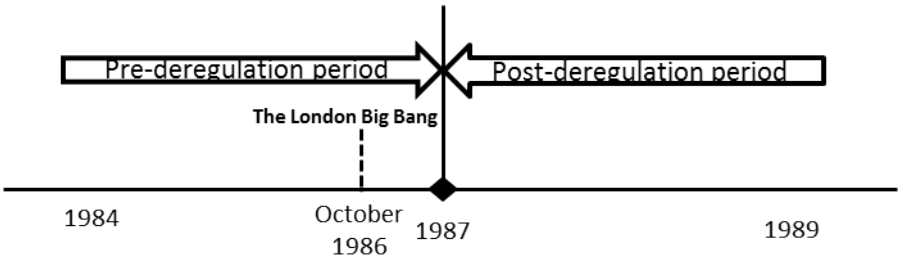

Figure 1: Timeline of the identification strategy

Table 2.1: Descriptive statistics (Firm level analysis)

This table reports summary statistics of my innovation measures both for the British, Dutch and Italian firms, namely patents counts and citations counts. The observation period is from 1981 to 1992.

Panel A Patent counts	Firms	Average (12 yrs)	Average (6 yrs)	Average, before BB	Average, after BB
UK	41	11	11	10	13
UK, High EFD	19	16	17	14	19
UK, Low EFD	22	7	8	8	7
Netherlands	34	6	6	5	6
Netherlands, High EFD	19	4	3	3	4
Netherlands, Low EFD	15	8	8	7	8
Italy	28	5	5	5	5
Italy, High EFD	13	6	6	6	6
Italy, Low EFD	15	4	3	3	4

Panel B Citations counts	Firms	Average (12 yrs)	Average (6 yrs)	Average, before BB	Average, after BB
UK	41	88	98	92	103
UK, High EFD	19	140	158	142	173
UK, Low EFD	22	54	58	60	56
Netherlands	34	45	44	38	49
Netherlands, High EFD	18	33	30	25	35
Netherlands, Low EFD	19	59	59	54	63
Italy	28	31	30	33	27
Italy, High EFD	13	39	40	46	33
Italy, Low EFD	15	22	18	16	20

Table 2.2: Descriptive statistics (Industry level analysis)

This table reports summary statistics at industry level of my innovation measures classified according to the Hsu, Tian and Xu (2014) mapping strategy. The sample period is from 1984 to 1989.

SIC	Industries	Patents	Citations
20	Food and Kindred Products	23	190
21	Tobacco Products	5	25
22	Textile Mill Products	4	29
23	Apparel and Other Finished Products, made from Fabrics and Similar Materials	2	14
24	Lumber and Wood Products, Except Furniture	3	28
25	Furniture and Fixtures	11	108
26	Paper and Allied Products	58	569
27	Printing, Publishing, and Allied Industries	7	57
28	Chemicals and Allied Products	406	3141
29	Petroleum Refining and Related Industries	58	419
30	Rubber and Miscellaneous Plastics Products	29	232
31	Leather and Leather Products	1	11
32	Stone, Clay, Glass, and Concrete Products	35	287
33	Primary Metal Industries	33	223
34	Fabricated Metal Products, except Machinery and Transportation Equipment	43	327
35	Industrial and Commercial Machinery and Computer Equipment	300	2690
36	Electronic and Other Electrical Equipment and Components, except Computer Equipment	327	2908
37	Transportation Equipment	274	2007
38	Measuring, Analyzing, Controlling Instr.; Photographic, Medical, Optical goods, Watches, Clocks	169	1649
39	Miscellaneous Manufacturing Industries	12	119

Table 2.3: Firm level analysis

This table reports the results estimating various forms of $Innovation_{i,t} = \alpha_1 + \beta_1 * Dep_j * BigBang_t + \delta * X_{i,t} + \mu_i + \gamma_t + e_{i,t}$. $Innovation_{i,t}$ is one of the two measures of the innovation output (either $Pats_{i,t}$ in Panel A or $Cits_{i,t}$ in Panel B). The measure $Pats_{i,t}$ counts the number of successful patents applications per firm i in year t. The measure $Cits_{i,t}$ counts the number of forward patents citing the patents of firm i in year t. $BigBang_t$ is a dummy that equals one if a firm-year observation is from the year after 1986 and zero otherwise. Dep_j is a dummy that equals one if an observation belongs to an industry with high external finance dependence measure and 0 otherwise. X is a vector of control variables, μ_i are firm fixed effects and γ_t are time fixed effects. All regressions include a constant term (unreported). Standard errors are clustered by firm in column (1) and (3) and by industry in column (2). Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 1984 to 1989.

Panel A Dependent variable: patent counts			
	(1)	(2)	(3)
DiD	6.11*	6.11*	11.34*
	(3.33)	(3.41)	(6.67)
Firm FE	YES	NO	YES
Industry FE	NO	YES	NO
Year FE	YES	YES	YES
Controls	NO	NO	YES
Obs	246	246	142
R2	0.07	0.03	0.12
Panel B **Dependent variable: citation counts**			
	(1)	(2)	(3)
DiD	34.15*	34.15**	55.33*
	(18.28)	(15.82)	(31.67)
Firm FE	YES	NO	YES
Industry FE	NO	YES	NO
Year FE	YES	YES	YES
Controls	NO	NO	YES
Obs	246	246	142
R2	0.03	0.06	0.12

Table 2.4: Firm level analysis, UK sample and control group

This table reports the results estimating various forms of $Innovation_{i,t} = \alpha_1 + \beta_1 * BigBang_t * Country_i + \beta_2 * BigBang_t * Dep_j + \beta_3 * Dep_j * BigBang_t * Country_i + \mu_i + \gamma_t + e_{i,t}$. $Innovation_{i,t}$ is one of the two measures of the innovation output (either $Pats_{i,t}$ or $Cits_{i,t}$). The measure $Pats_{i,t}$ counts the number of successful patents applications per firm i in year t. The measure $Cits_{i,t}$ counts the number of forward patents citing the patents of firm i in year t. $BigBang_t$ is a dummy that equals one if an firm-year observation is from the year after 1986 and zero otherwise. Dep_j is a dummy that equals one if an observation belongs to an industry with high external finance dependence measure and 0 otherwise. $Country_i$ is a dummy that equals one if a firm-year observation belongs to a British firm and zero otherwise. μ_i are firm fixed effects and γ_t are time fixed effects. All regressions include a constant term (unreported). Standard errors are clustered by firm. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 1984 to 1989.

Innovation	DiD	Firm FE	Obs	R2
Patents (1)	6.00***	YES	630	0.06
	(1.31)			
Citations (2)	30.16***	YES	630	0.06
	(10.49)			

Table 2.5: Firm level analysis, parallel trends

This table reports the results estimating various forms of $Innovation_{i,t} = \alpha_1 + \beta_1 * EarlyBigBang_t + \beta_2 * Dep_j + \beta_3 * Dep_j * EarlyBigBang_t + \mu_i + \gamma_t + e_{i,t}$. $Innovation_{i,t}$ is one of the two measures of the innovation output (either $Pats_{i,t}$ or $Cits_{i,t}$). The measure $Pats_{i,t}$ counts the number of successful patents applications per firm i in year t. The measure $Cits_{i,t}$ counts the number of forward patents citing the patents of firm i in year t. $EarlyBigBang_t$ is a dummy that equals one if an firm-year observation is from a year after 1983 and zero otherwise. Dep_j is a dummy that equals one if an observation belongs to an industry with high external finance dependence measure and 0 otherwise. μ_i are firm fixed effects and γ_t are time fixed effects. All regressions include a constant term (unreported). Standard errors are clustered by firm. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 1981 to 1986.

Innovation	DiD	Firm FE	Year FE	Obs	R2
Patents (1)	-1.82	YES	YES	246	0.02
	(2.48)				
Citations (2)	-2.99	YES	YES	246	0.002
	(35.33)				

Table 2.6: Industry level analysis

This table reports the results estimating various forms of $Innovation_{j,t} = \alpha_1 + \beta_1 * BigBang_t + \beta_2 * Dep_j + \beta_3 Dependence_j * BB_t + e_{j,t}$. $Innovation_{j,t}$ is one of the two measures of the innovation output (either $Pats_{j,t}$ in row (1) or $Cits_{j,t}$ in row (2). The measure $Pats_{j,t}$ counts the number of successful patents applications per industry j in year t. The measure $Cits_{j,t}$ counts the number of forward patents citing the patents in industry j that are invented by individuals or non-government institutions in year t. $BigBang_t$ is a dummy that equals one if an industry-year observation is from the year after 1986 and zero otherwise. Dep_j is a dummy that equals one if an observation belongs to an industry with high external finance dependence measure and 0 otherwise. $e_{j,t}$ denotes the error term. All regressions include a constant term (unreported). Robust standard errors clustered by industry are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. My sample includes industries with two-digit SIC codes between 20 and 39. The sample period is from 1984 to 1989.

Innovation	Big Bang	DiD	Obs	R2
Patents (1)	-15.60*	19.37***	120	0.29
	(8.54)	(8.19)		
Citations (2)	-131.54*	156.62***	120	0.30
	(70.64)	(64.93)		

Table 2.7: Industry level analysis, alternative measures of external finance dependence

This table reports the results estimating various forms of $Innovation_{j,t} = \alpha_1 + \beta_1 * BigBang_t + \beta_2 * DepMeasure_j + \beta_3 DepMeasure_j * BigBang_t + e_{j,t}$. $Innovation_{j,t}$ is one of the two measures of the innovation output (either $Pats_{j,t}$ in row (1) and (3) or $Cits_{j,t}$ in row (2) and (4)). The measure $Pats_{j,t}$ counts the number of successful patents applications per industry j in year t. The measure $Cits_{j,t}$ counts the number of forward patents citing the patents in industry j that are invented by individuals or non-government institutions in year t. $BigBang_t$ is a dummy that equals one if an industry-year observation is from the year after 1986 and zero otherwise. In rows (1) and (2) $DepMeasure_j$ is $DepEQ_j$, the measure of external finance dependence for industry j borrowed from the equity finance measure of Rajan and Zingales (net amount of equity issues to capital expenditures), while in rows (3) and (4) it is $DepUK_j$, namely the measure calculated with the UK data. $e_{j,t}$ denotes the error term. All regressions include a constant term (unreported). Robust standard errors clustered by industry are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. My sample includes industries with two-digit SIC codes between 20 and 39. The sample period is from 1984 to 1989.

Innovation	Big Bang	DiD	Obs	R2
Patents (1)	-15.08	20.39***	120	0.28
	(10.57)	(9.80)		
Citations (2)	-148.90	180.21***	120	0.30
	(81.36)	(74.79)		
Patents (3)	-8.06	14.34*	120	0.34
	(11.28)	(8.73)		
Citations (4)	-91.41	129.87*	120	0.26
	(87.13)	(68.96)		

Table 2.8: Industry level analysis, Difference in Difference in Differences

This table reports the results estimating various forms of $Innovation_{j,t} = \alpha_1 + \beta_1 * BigBang_t + \beta_2 * Dep_j + \beta_3 * Manufacturing_j + \beta_4 * Dep_j * BigBang_t + \beta_5 * Dep_j * Manufacturing_j + \beta_6 * BigBang_t * Manufacturing_j + \beta_7 * BigBang_t * Manufacturing_j * Dep_j + e_{j,t}$. $Innovation_{j,t}$ is one of the two measures of the innovation output (either $Pats_{j,t}$ in row (1) or $Cits_{j,t}$ in row (2)). The measure $Pats_{j,t}$ counts the number of successful patents applications per industry j in year t. The measure $Cits_{j,t}$ counts the number of forward patents citing the patents in industry j that are invented by individuals or non-government institutions in year t. $BigBang_t$ is a dummy that equals one if an industry-year observation is from the year after 1986 and zero otherwise. Dep_j, is the measure of external finance dependence for industry j over the observation period. $Manufacturing_j$ denotes industries belonging to SIC classes from 20 to 39. $e_{j,t}$ denotes the error term. All regressions include a constant term (unreported). Robust standard errors clustered by industry are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. My sample includes industries with two-digit SIC codes between 1 and 99. The sample period is from 1984 to 1989.

Innovation	Big Bang	Dependence	DiDiD	R2
Patents (1)	1.10	0.19	16.47**	0.45
	(.40)	(0.14)	(7.03)	
Citations (2)	10.62	1.85	134.26**	0.45
	(51.34)	(2.95)	(54.55)	

Table 2.9: Industry level analysis, parallel trends

This table reports the results estimating various forms of $Innovation_{j,t} = \alpha_1 + \beta_1 * EarlyBigBang_t + \beta_2 * Dep_j + \beta_3 * EarlyBigBang_t * Dep_j + e_{j,t}$. $Innovation_{j,t}$ is one of the two measures of the innovation output (either $Pats_{j,t}$ in row (1) or $Cits_{j,t}$ in row (2)). The measure $Pats_{t,j}$ counts the number of successful patents applications per industry j in year t. The measure $Cits_{j,t}$ counts the number of forward patents citing the patents in industry j that are invented by individuals or non-government institutions in year t. $EarlyBigBang_t$ is a dummy that equals one if an firm-year observation is from a year after 1983 and zero otherwise. Dep_j, is the measure of external finance dependence for industry j over the observation period. $e_{j,t}$ denotes the error term. All regressions include a constant term (unreported). Robust standard errors clustered by industry are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 1981 to 1986.

Innovation	Dependence	DiD	Obs	R2
Patents (1)	91.30**	-10.94	120	0.20
	(37.94)	(24.94)		
Citations (2)	739.81**	-74.70	120	0.18
	(305.83)	(209.11)		

Table 2.10: Possible mechanism: SEO's and long term loans issue

This table reports the results estimating various forms of $Channel_{i,t} = \alpha_1 + \beta_1 * Dep_i * BB_t + \mu_i + \gamma_t + e_{i,t}$. $Channel_{i,t}$ is one of the two possible underlying mechanisms. In row (1), I use SEO proceeds, while in row (2) I scale SEO Proceeds by total fixed assets of the previous year. In row (3) the dependent variable is the issue of long term loans, while in row (4) I scale the issue of long term loans by total fixed assets of the previous year. μ_i are firm fixed effects and γ_t are time fixed effects. $e_{i,t}$ denotes the error term. All regressions include a constant term (unreported). Robust standard errors clustered by firm are reported in parenthesis. Significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 1984 to 1989.

Channel	DiD	Firm FE	Year FE	Adj. R2
SEO proceeds (1)	-5'315'072	YES	YES	0.04
	(6'105'251)			
SEO proceeds, scaled (2)	2.66	YES	YES	0.01
	(18.64)			
Issue of long term loans (3)	-84'747**	YES	YES	0.01
	(42'522)			
Issue of long term loans, scaled (4)	-0.10**	YES	YES	0.04
	(0.04)			

Chapter 3

Financial vs. strategig buyers: who is waiting at the gate?

Chiarella, C., Ostinelli, D., Financial vs. strategig buyers: who is waiting at the gate?, Working Paper, 2016

I Introduction

Deal-making activity in the last three decades has been characterized by the presence of financial sponsors (private equity firms). Yet, the fraction of financial sponsors' activity over total M&A activity is not constant over time. This paper addresses the following question: how does the relative importance of financial sponsors and strategic buyers change over time in the market for corporate control? This question is relevant not only for understanding the dynamics of the deal making environment, but also because of the consequences bidder identity has on target companies, in particular with regards to organizational status, performance, corporate governance and capital structure.

Financial sponsors and strategic buyers, who potentially compete for the same investment opportunity, have several intrinsic differences. Financial sponsors usually look for targets with high cash flow generation potential. After the acquisition, the company is temporarily part of its financial portfolio and is successively resold to a strategic buyer or goes public through an IPO. Strategic buyers, which are more long term oriented, usually aim at realizing synergies, through economies of scale or by eliminating duplicate functions.[1] Moreover, strategic buyers listed on public equity markets have additional payment methods, since in exchange of the shares of the target company they may offer their own shares, cash, or a combination of the two. Financial sponsors, in contrast, pay only with cash.

Thus, the conditions of the debt and stock markets, which are important factors for M&A activity since they affect the fundamental drivers of deal performance, may also affect the bidding behavior of the different bidders. In accordance with this line of inquire, in this paper we aim to understand the drivers and the dynamics of the market for corporate control by relating financial sponsors and strategic buyers' M&A activity to prevailing conditions on debt and stock markets.

In the first part of our paper, we aggregate financial sponsors and strategic buyers' M&A activity in the euro area between 2000 and 2015 over years and industries. While

[1] In the theoretical model of Hege et al. (2013), private equity is a transitional form of ownership, with private equity firms acquiring an asset which will be divested via an exit auction.

M&A activity comes in waves, our analysis shows that financial sponsors and strategic buyers-related deal flows are not synchronous. First, we find that the relative contribution of financial sponsors grows with credit tightness and, consistently with Martos-Vila et al. (2013), drops when the difference between their credit risk premium and strategic buyers' credit risk premium – which for simplicity we label yield spread – widens. We then examine the relationship between stock market valuations and M&A activity and find that the relative contribution of financial sponsors drops with high stock market valuations.

Favourable conditions in debt markets are usually associated with higher M&A activity. Harford (2005) shows that liquidity in debt markets and ease of financing are necessary conditions for the reallocation of assets. Credit availability affects, in fact, the financial costs and the equity contribution of acquirers. Indeed, in principle, cheap and abundant credit allows the realization of more leveraged transactions at lower costs, boosting the returns on deals. Furthermore, lower cost of funding potentially expands bidders' investment opportunity set to include larger target companies or target companies with lower cash flow generation power. On both counts, favourable conditions in debt markets are then associated with higher M&A activity.

With regards to stock markets conditions, Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004) identify valuations as a trigger of M&A activity, since overvalued acquirers bid more and overvalued targets are more willing to accept offers when valuations are high. In principle, in fact, stock market prices should reflect future expectations grounded in economic fundamentals, such as growth opportunities and the equity risk premium. Thus, when an economy is in good condition, bidders are not necessarily discouraged by high valuations, as they tend to be more confident they can achieve higher cash flows. Furthermore, stock market valuations also reflect the cost of equity, with higher valuations corresponding to lower cost of equity. As a consequence, future growth in performance which is not yet reflected in valuations is more valuable when it is discounted at a lower average discount rate. This increases

bidders' willingness to tying up resources in less liquid and riskier investments to achieve higher returns when valuations are high. As a consequence, then, M&A activity will be high too.

We interpret our results as a combination of a number of factors: leverage is an essential part of the financial sponsors' governance model, and the need to lever up transactions to achieve the high returns required by their investors makes financial sponsors relatively slow to react to credit tightness. Still, while increasing credit risk premium increases the tax benefits of debt, it also forces financial sponsors to reduce leverage (see Axelson et al. (2013)). Moreover, when the yield spread increases, strategic buyers have relatively better conditions for external funding, and therefore they may take advantage of this situation to increase their share in the market for corporate control. Turning to stock market valuations, we interpret our findings as reflecting financial sponsors' short term investment horizon combined with their inability to capture synergies, which make them relatively wary about high company valuations and potential overpayment that would hinder their returns.[2]

For all our specifications, we repeat the analysis considering the subsample of deals settled by cash only, with the aim to exclude that our findings are affected by the method of payment, and find similar results. These findings suggest that, at least in our sample, the additional method of payment that strategic buyers may use does not drive our results.

Next, we turn to our deal level analysis. First, we study how the probability of a deal being backed by a financial sponsor or a strategic buyer varies according to debt and stock market conditions. We find that the likelihood that an acquisition is backed by a financial sponsor decreases when the extra cost of borrowing for financial sponsors relative to strategic buyers increases, while it is unaffected by shifts in credit availability and stock market valuations.

Second, we investigate two main channels explaining our results at the aggregate

[2]Private equity investment horizon is characterized by at least two distinctive features: first, private equity funds have a finite period in which to invest their capital (see Degeorge et al. (2016)). Second, the typical private equity fund partnership contract stipulates that funds have a life of 10 years, with a possible extension of 3 years (see Phalippou and Gottschalg (2009)).

level by studying separately our subsamples of financial sponsors and strategic buyers. First, we find that the yield spread has a substantial effect on the takeover premium paid in deals backed by strategic buyers, but not for those backed by financial sponsors. Second, we find that strategic buyers reduce the deal size with credit tightness, while when stock market valuations increase, the deal size increase more for strategic buyers than for financial sponsors.[3]

These findings shed further light on our industry level results. When the yield spread increases, strategic buyers crowd out financial sponsors from the market for corporate control, reducing at the aggregate level financial sponsor's share both in terms of number of deals and deal values. Furthermore, credit availability and stock market valuations affect strategic buyers' deal size, potentially explaining why at the aggregate level when credit availability shrinks and stock market valuations increase, strategic buyers respectively decrease and increase their share of the M&A volume, while their relative number remains constant.

Our results contribute to the literature on deal making behaviour by financial sponsors, which originated in the late 1980s as a response to an unprecedented number of public corporations and their divisions going private in leveraged buyout transactions. The debate in the literature started by focusing on the longevity of LBOs and their distinguishing characteristics: while Rappaport (1989) argues that the LBO organization is transitory and that high level of debt along with concentrated ownership impose costs of inflexibility to competition and change, in his influential paper Jensen (1997) considers the LBO a superior organization, due to its unique combination of powerful incentives that increase efficiency and value. Jensen (1997) argues that common LBO features, such as concentrated ownership, monitoring, managerial incentives and efficient capital structure, make LBOs preferable to public corporations, which are characterized by dispersed shareholders and weak governance.

Since then, empirical research has scrutinized many other aspects of the effects of financial sponsors on the company they acquire, such as operating performance, invest-

[3]When we exclude deals settled by stock or a combination of cash and stock we find similar results.

ments, organizational status and capital structure. While Axelson et al. (2013) find that buyouts have higher leverage than a matched sample of public companies, Kaplan (1989) analyzes a sample of buyouts of public companies and finds that companies with available post buyout financial data experience an increase in operating income and net cash flow as well as reductions in capital expenditures. Stein (1989) interprets these findings in two ways: on the one hand they may represent better operational efficiency and the curtailment of negative NPV projects, but it cannot be excluded that some positive NPV projects are eliminated as well. Focusing on the monitoring and advising functions exerted by financial sponsors, Lerner et al. (2011) analyze a sample of LBO transactions and find that while their overall patenting output remains unchanged, the innovation quality of LBO firms increases in the years following the transaction.

An additional dimension potentially affected by the buyer's type is the organizational status. Kaplan (1991) examines 183 large LBOs completed between 1979 and 1986 from the time of their completion through August 1990. He finds that 62% of the LBO companies remain privately owned, 14% are publicly owned and still independent, and 24% are purchased by publicly owned U.S. or foreign companies, and that the percentage of LBOs returning to public ownership increases over time. Thus, whereas the nature of LBO's does not seem to be permanent, at least in the immediate years following the takeover firms acquired by financial sponsors modify their organizational status.[4]

Only a few papers so far have tried to shed light on the drivers of financial sponsors activity or to compare it with the overall M&A activity. Recent papers by Bargeron et al. (2008), Hege et al. (2013) and Dittmar et al. (2012) focus on bidding behavior and target premiums between strategic and financial acquirers. Gorbenko and Malenko (2014) consider the bidding behavior of strategic versus financial bidders focusing on how synergies cause different bidding behavior than the search for undervalued assets. Shivdasani and Wang (2011) report that structured credit fuelled the most recent buy-

[4]Further research has focused on the benefits and potential detrimental effects of being listed on public equity markets, both from a theoretical and from an empirical perspective. Stein (1989) proposes a model where capital market pressure negatively affects firm's performance through managerial myopic behaviour while Ferreira et al. (2014) show in theory paper that private ownership creates incentives for innovation, whereas public ownership deters innovation. Empirical evidence on the role of public markets in nurturing innovation is mixed (see for example Acharya and Xu (2016), Hsu et al. (2014), and Bernstein (2015)).

out boom, using cross-sectional evidence to argue that the advent of structured credit improved access to capital for financial sponsors. Similarly, Kaplan and Stein (1993) observe important changes in the structure of deals with the emergence of the high yield market. Haddad et al. (2013) offer an explanation of the time series variation of buyout activity by which financial sponsors activity should be high when risk free rates are high and or the risk premium is low, due to the benefits and costs of concentrated ownership. Still, they do not consider the competition between financial and strategic buyers.

Our paper is closest to Martos-Vila et al. (2013), which provide an explanation for the dynamics of financial versus strategic acquisition activity focusing on mispricing in the debt market.[5] While Martos-Vila et al. (2013) measure private equity activity as the fraction of the value of all deals for public targets accounted for by financial sponsors, we also consider non-public targets. Since previous studies on LBOs found that public-to-private transactions account only for a tiny portion of the overall LBO activity, we believe that including non-public targets provides a more comprehensive picture of the financial acquirers activity.[6] Moreover, in addition to Martos-Vila et al. (2013) we look at the propensity to embark on a transaction for different buyer types which, along with our analysis of deal characteristics such as the takeover premium and the deal size, allows us to better understand and interpret our findings at the aggregate level.

The rest of this paper is organized as follows. Section 2 describes our data collection and provides summary statistics. In section 3 we formulate our hypotheses. Section 4 describes our empirical analysis. Section 5 concludes.

[5] In addition, Malenko and Malenko (2015) provide an alternative theoretical model for financial sponsors activity based on the variation of the risk premium, emphasizing the ability of financial sponsors' owned firms to borrow against their sponsors' reputation with creditors and on other externalities.

[6] By looking at the type of sellers involved in a sample of French transactions, Boucly et al. (2011) find that the 4.3% of the transactions are public to private, while Strömberg (2008) finds similar results for a sample of global buyouts.

II Data

The sample includes all completed deals by euro area strategic buyers and financial sponsors announced in the period between 2000 and 2015. Data are collected from Bloomberg, as this allows us to directly observe the aggregate deal flow and then classify each individual observation on the basis of the bidder type: strategic buyer or financial sponsor. This assures homogeneous deal coverage and common inclusion criteria across bidder types. We include an observation in the sample if:

- the announced transaction value is above 50 million USD
- the transaction is not a buy back, is not an exchange offer, and leads to the acquisition of 100% of the target company
- the acquirer, if belonging to the strategic buyer bidder type, is not a financial institution

Our sample includes 2560 deals, of which 258 were executed by financial sponsors and the remaining 2302 by strategic buyers. Figure 1 shows the yearly breakdown of the number of deals between financial sponsors and strategic buyers and shows the relative contribution of financial sponsors to total deal volume in Europe. Overall M&A activity varies significantly from one year to the other and clusters in time, consistent with the extant literature on mergers waves and valuation.[7] While strategic buyers always dominate that of financial sponsors, the fraction of financial buyers over total M&A activity varies over time, both in terms of the number of deals and aggregate deal volume.

—Insert Figure 1 about here—

Table 1 provides some insights into the composition of the sample. Summary statistics on deal and target characteristics are presented for the whole sample and for subsamples of deals undertaken respectively by strategic buyers and financial sponsors. On

[7] Harford (2005) analyzes a sample of industry-level merger waves in the 1980s and 1990s and finds that merger waves occur in response to specific industry shocks that require large scale reallocation of assets paired with sufficient capital liquidity.

average, deal value is about 812.2 million Eur and, for the set of deals for which we have this information, a considerable 27.5% takeover premium is paid in excess of the undisturbed market capitalization of the target before the announcement. When looking at the breakdown between financial and strategic buyers, some interesting features arise: first, average deal value does not differ significantly across different bidder types, suggesting that on average financial and strategic buyers in our sample bid for targets with similar size. As expected, cash is the prevalent means of payment by financial sponsors, while a minority yet substantial share of deals by strategic buyers is settled using stock payment.[8] Consistent with Gorbenko and Malenko (2014), we also find that strategic buyers pay on average a substantially higher takeover premium, which suggest that strategic buyers have a greater willingness to recognize higher valuations justified on the basis of expected synergies.

—Insert Table 1 about here—

III Hypothesis Development

While some takeovers happen following bilateral negotiations between the selling shareholders and just one acquirer, many takeovers involve a multitude of bidders, usually with both strategic and financial buyers competing for the target. In this competitive environment, the value accorded to the target company and bidder's financial constraints concur in determining the winner. Stock market valuations and debt market conditions affect target company valuation and bidder's financial constraints, respectively. Due to their intrinsic differences, strategic and financial buyers respond differently to variations of these two factors; therefore, we expect that stock market valuations and debt market conditions play an important role in determining the composition of the M&A deal flow over time.

Financial and strategic buyers differ over several dimensions. Financial sponsors usually have a short term investment horizon and they are primarily interested in the

[8]For 8 deals backed by financial sponsors the method of payment is undisclosed and for 3 deals is a combination of stock and cash. As shown later, our results are unaffected by the exclusion of these deals.

return they can achieve by acquiring a target company and selling it in a later point in time.[9] Financial sponsors may obtain this desired return by looking at undervalued targets which they often reorganize in order to improve their cash flow. In contrast, strategic buyers typically integrate the companies they buy after making sure that they offer long-term operational synergies and fit into their strategic plans. Reasons for acquisitions may include vertical expansion (buying a customer or a supplier), horizontal expansion (new geographic markets or product lines), eliminating competition, or enhancing some of their intrinsic capabilities, such as technology, research and development, or marketing.

If financial and strategic buyers are capital-constrained, so that they have to raise external debt in order to complete deals, the supply of debt and its cost potentially affect their bidding behavior and increase or decrease their contribution to the total M&A deal flow. As an example of the importance of the debt market for M&A activity, the takeover boom of the 1980s was characterized by heavy use of leverage and by noninvestment grade or junk bonds, which increased substantially throughout the 1980s together with leveraged buyouts.[10] In order to analyze the prevailing conditions of debt markets, we disentangle credit availability from credit risk premium, which both concur in determining financial and strategic buyers' borrowing costs. With credit availability we aim at capturing the ease to borrow money, which is represented by the risk free rate. When abundant credit is available the risk free rate is low, while a high risk free rate represents credit tightness. An increase in the risk free component of the debt negatively affects the borrowing costs of both financial and strategic buyers. Still, since financial sponsors have a proven ability to use debt in their acquisitions and leveraging up transactions is part of their value creation strategy, we expect that they are less sensitive than strategic buyers to credit tightness.[11] With this regard, Axelson et al.

[9]For a sample of US financial sponsors, Kaplan and Strömberg (2009) find that in 38% of all exits financial sponsors sell companies to a strategic buyer, in 24% to other financial sponsors and in 14% they exit their investment through an IPO.

[10]Noninvestment grade or junk bonds are bonds that are rated below investment grade with higher yields and higher risks than investment grade bonds. Holmstrom and Kaplan (2001) find that in the mid-to-late 1980s, more than 50 percent of junk bond issues were related to takeovers or mergers.

[11]The average debt to total capital ratio (i.e. long-term debt as a percentage of debt plus equity) for public companies preceding a buyout is about 20% for public companies and increases to 85% on completion of the buyout (see Jensen

(2013) find that buyout leverage is unaffected by variations in the risk free rate, while leverage of comparable publicly-traded firms increases when the risk free rate is low and vice-versa. Thus, previous empirical findings related both on different levels of leverage and on different responsiveness to credit tightness suggest us our first hypothesis:

Hypothesis 1 (H1): strategic buyers are more sensitive to credit tightness; increasing risk-free rate augments financial sponsors' share in the market for corporate control

While credit availability affects both constrained financial sponsors and constrained strategic buyers, their credit risk premia are different. In particular, when investors' appetite for risk is low the credit risk premium is high, while a low credit risk premium is a consequence of a high demand for risky assets. To estimate the effects of debt market conditions, the literature on financial sponsors has analyzed the relationship between leverage and the high-yield spread. Axelson et al. (2013) find that an increase in the high-yield spread, which measures financial sponsors' credit risk premium and is calculated as the difference between a high-yield rate and the risk free rate, negatively affects the leverage used in buyout transaction. Thus, if higher credit risk premium harms financial sponsors' willingness to borrow money, strategic buyers may take advantage to increase their share in the market for corporate control. Still, debt market conditions affect strategic buyers' credit risk premium too. Therefore, in order to consider this joint effect, we calculate the differential credit risk premium as the difference between a high-yield rate and an investment grade rate, which represents the extra cost that financial sponsors have to pay to raise debt compared to strategic buyers. The expected effect of a variation in the differential credit risk premium, or yield spread for simplicity's sake, is straightforward and leads to our second hypothesis:

Hypothesis 2 (H2): the yield spread represents the extra cost paid by financial buyers only; increasing yield spread augments strategic buyers' share in the market for corporate control

Beside financial constraints, synergies play a pivotal role in the determination of the

(1997))

bidding price for strategic buyers. In principle, strategic buyers should be willing to pay more than financial sponsors, since they can implement the same changes as the latter and, on top of that, enjoy the synergies generated by the acquisition. Gorbenko and Malenko (2014) find indeed that strategic buyers pay on average higher takeover premiums than financial sponsors and, more importantly, the estimated valuations of participating bidders in auctions of companies are higher for strategic buyers, confirming the common view that strategic bidders are willing to pay more for the average target due to potential synergies.[12]

Still, the value of the synergies varies over time, and therefore affect their decision to engage in a transaction. In particular, the value of synergies is affected by the discount rate, which in its turn reflects stock market valuations. Higher level of price to book ratio (P/B), our general measure of stock market valuations, implies lower discount rate, and consequently higher synergies value, which should increase the relative importance of strategic buyers in the M&A deal flow composition. This leads to our third hypothesis:

Hypothesis 3 (H3): synergies affect strategic buyers' bidding price. Increasing P/B ratio augments strategic buyers' share in the market for corporate control

IV Empirical Analysis

We conduct our empirical analysis of M&A activity by financial sponsors and strategic buyers first at the industry level and then at the deal level. In particular, with our industry level analysis we aim to capture the within industry effects of varying market conditions on M&A activity by financial sponsor and strategic buyers, taking into account the intrinsic differences across industries, such as their different appeal to different types of bidders, and the fact that deals tend to cluster in time and industries. Then, we corroborate our findings by analyzing, at the individual deal level, the effects

[12] In addition, Gorbenko and Malenko (2014) find that valuations of strategic and financial bidders varies across targets and is responsive to investment opportunities and cash flows.

of varying stock and debt market conditions on the propensity to embark on a transaction for different buyer types, as well as on the size of deals they undertake and the takeover premium.

In both cases, we conduct our analysis for the full sample and for a subsample that includes only the deals for which cash was used as the method of payment. First, we run our analysis taking all the deals in our sample, regardless of the method of payment. This full sample analysis is motivated by the fact that we are interested in comparing the relative eagerness of different types of bidders to make a deal under varying financial conditions, regardless of the fact that strategic buyers have greater flexibility in the choice of the payment method. Second, we repeat the analysis considering only the subsample of deals for which cash is the only means of payment to make sure that our results are not driven in any significant way by the fact that strategic buyers can benefit from using stocks as a means of payment when deals are larger in size or potential stock mispricing is higher.[13]

IV.I Industry Level Analysis

We investigate first the link between financial sponsors' M&A activity and credit availability, credit risk premia and stock market valuations by looking at the proportion of financial sponsors related deal flow under varying conditions in financial markets. In particular, our intuition is that if financial sponsors and strategic buyers were analogously affected by credit availability, credit risk premium, and stock market valuations, their corresponding deal flows would be synchronous. In other words, the number of deals or the deal volume could vary over time, but the relative composition to the deal flow would remain constant. On the contrary, a comparative lack or abundance of financial sponsors related deal flow when valuations are particularly high or low or when credit availability and credit risk premia are more or less favorable would be interpreted as evidence of the impact of respectively pricing and debt market conditions on M&A

[13]Hansen (1987) presents a theory for the choice of exchange medium in mergers and acquisitions, arguing that when uncertainty is higher, the bidder company prefers stock over cash in order to mitigate the overpayment risk. On the empirical side, Faccio and Masulis (2005) find evidence with a sample of European companies that the target size is negatively correlated with the proportion of cash used as a method of payment.

activity by financial sponsors.

We construct our measures of financial sponsors activity annually $FSNUM_{t,j}$ and $FSVAL_{t,j}$ by dividing the number or the value of all deals by financial sponsors in a given industry over the total deal flow in the same industry, which we classify as following: Basic Materials, Communications, Consumer-Cyclical, Consumer-Non Cyclical, Energy, Industrials, Technology, and Utilities. We obtain a panel of 128 year-industry observations, where the subscript t denotes the year of the transaction and j the industry to which the target firm belongs and we model the contribution of financial sponsors to total deal flow as a function of a vector of a set of financial variables:

$$Y_{j,t} = a + bX_t + \nu_j + e_{j,t} \tag{3.1}$$

$Y_{j,t}$, the dependent variable, is either $FSNUM_{t,j}$ and $FSVAL_{t,j}$. Our set of independent variables includes: $CreditAvailability_t$, which captures the varying conditions on the markets for debt, $CreditRiskPremium_t$, which accounts for the extra cost that high yield borrowers have to pay to raise debt and $StockMarketValuations_t$, which captures the level of equity markets valuations. In particular, we proxy for the availability of credit by means of the euro area Euribor 3-month rate. High values of our variable $CreditAvailablility_t$ correspond to credit tightness, and vice versa. Then, with the aim to consider the different costs of borrowing, we disentangle credit availability from credit risk premium by looking at the spread between the annual yields offered by the constituents of the Barclays Corporate European High Yield Bond Index over those of the the FTSE Corporate European 10+ Maturity Bond Index. Keeping in mind that high yield debt issuance is not exclusively but more intrinsically related to financial sponsors, we consider higher values of our variable $CreditRiskPremium_t$ to correspond to a wider gap in the cost of borrowing for financial sponsors relative to strategic buyers. Shifts in stock markets levels are measured on the basis of the Price to Book ratio of the EUROSTOXX 50 index.[14] Finally, ν_j are industry fixed effects at

[14]We choose to proxy for stock market valuations by means of the Price to Book ratio of the EUROSTOXX 50 to be consistent with the country of origin of the bidders in our sample. Notice that the observations for the price to book

the target level, when included.

Table 2 provides summary statistics for the variables included in our analysis. We observe substantial variation in our financial and macroeconomic variables over the sample period. Indeed, the sample period comprises quite a few distinct intervals of recognized turmoil and changing macroeconomic conditions. For example, that from March 2000 to October 2002 characterized by a plunge of the stock markets due to the Tech Bubble bursting, or the one following Lehman Brothers collapse in October 2008, marked by unfavorable credit conditions combined with high investors' uncertainty and lower valuations, or the period following the adoption of quantitative easing, characterized instead by cheap credit paired with recovered investor confidence and high stock market valuations.

—Insert Table 2 about here—

Results

In this section we present our main results and discuss the main findings of our industry level analysis. We estimate our model by industry-level panel regressions.[15] Each panel in Table 3 reports the coefficients and clustered standard errors by industry (in parenthesis) for four different alternative specifications of our model. In the first panel the dependent variable is the fraction of deals by financial sponsors in a given industry over the total deal flow in the same industry, measured in columns (1) and (2) on the basis of the number of deals and in columns (3) and (4) on the basis of the value of deals. In the second panel we repeat the analysis considering only the subsample of deals for which cash is the only means of payment.

Our industry-level analysis uncovers substantial differences in the way in which financial sponsors and strategic buyers react to shifts in credit availability, borrowing costs and stock market valuations. Indeed, our findings suggest that deal flows for different

ratio of the EUROSTOXX 50 were not available for the years 2001 and 2002 and therefore we complete the time series by using the corresponding observations for the EUROSTOXX 600 index.

[15] We obtain analogous results by estimating a Tobit model of the fraction of financial sponsors in order to account for the potential censoring of the dependent variables. Results are available upon request.

types of buyers are not synchronous and the relative composition of deal flow changes in response to varying market conditions. In particular, we find that the relative contribution of financial sponsors to the total volume of deals grows when the availability of credit increases and the yield spread narrows, while it reduces when stock market valuations rise. These results are robust to the inclusion of fixed effects that we use to capture the within industry effects of varying market conditions on M&A activity by financial sponsor and strategic buyers, taking into account intrinsic unobserved differences across industries, such as their different appeal to different types of bidders or the fact that deals tend to cluster in time and industries.

Table 3 shows that when the Euribor rate gets higher, i.e. when credit availability becomes scarcer, financial sponsors increase their share of the total deal flow. The corresponding coefficient is positive in all our specification but it is statistically significant, at the 1% level, only for the regressions with the deal value. Shifts in debt market conditions have a stronger economic impact on the relative contribution of financial sponsors to the total volume of deals than the number of deals. In particular, a one standard deviation increase in the Euribor rate corresponds to a 2.0% growth in the relative contribution of financial sponsors to the number of deals and a 10.0% increase in their share of aggregate deal value. The magnitude of these effects is respectively 2.0% and 10.7%, when we consider the subsample of deals for which cash is used as the only means of payment.

This evidence is consistent with Martos-Vila et al. (2013) who find the same link between financial sponsors activity and debt market conditions analyzing a sample of deals for US public targets in the period between 1984 and 2005, as well as with Haddad et al. (2013) that argues that more LBOs should occur when risk free rates are high.[16] In the case of the risk free rate, a simple discount rate argument would not necessarily predict a relationship with the relative composition of deal flow, since it affects the value of discounted cash flows of both financial and strategic buyers. Thus, we interpret these results as evidence of a greater sensitivity of strategic buyers to

[16]Still, Haddad et al. (2013) consider only LBOs and not their relative contribution to the M&A activity as we do.

credit availability. On the contrary, for financial sponsors leveraging up transactions is part of their value creation strategy. Thus, this difference makes their response to debt market conditions smoother and allows them to increase their relative contribution to overall deal flow. Our interpretation is in line with Martynova and Renneboog (2009) who show that strategic buyers mostly resort to debt funding to finance their external growth and Harford (2005), who shows that overall liquidity in the debt markets or ease of financing is a necessary condition for M&A activity by strategic buyers. Moreover, Axelson et al. (2013) find that variations in the risk free rate do not affect buyout leverage, while comparable publicly-traded firms decrease their leverage when the risk free rate is high.

—Insert Table 3 about here—

The extra cost of borrowing that financial sponsors face as a results of the shorter horizon and the highly leveraged capital structure of their investments affects their relative contribution to deal flow in the opposite way. When the gap between the credit risk premium of high yield and investment grade issuers widens, i.e. when the difference between the borrowing of different types of buyers is larger, the relative contribution of financial sponsors to overall deal flow drops, both with respect to the number of deals and to deal values. The coefficient on the yield spread between high yield and investment grade issuers is negative and significant in all our specifications, at the 1% level when the number of deals is considered and at least at the 10% level for the value of deals. The economic impact on the relative contribution of financial sponsors to the total number and volume of deals is substantial. In particular, a one standard deviation increase in the yield spread corresponds to a 2.0% drop in the relative contribution of financial sponsors to the number of deals and a 3.5% drop in their share of aggregate deal value. The magnitude of these effects is respectively -2.4% and -4.2% when we consider the subsample of deals for which cash is used as the only means of payment.[17]

[17]We obtain similar results by substracting from the High Yield Bond Index the FTSE Corporate European All Maturities Yield Bond Index and by substracting from the High Yield Bond Index an average yield index with ratings from AAA to BBB (own calculations). Moreover, although the economic interpretation is different, we obtain similar results by substracting from the High Yield Bond Index the Euribor 3-month rate. Results are available upon request.

These results are in line with Martos-Vila et al. (2013), who find that financial sponsors decrease their contribution to the overall M&A activity when their borrowing costs increase and strategic buyers' borrowing costs decrease.[18]

Finally, stock market valuations affect the relative contribution of financial sponsors in a negative way. When stock market valuations are high, the relative contribution of financial sponsors to overall deal flow drops, both with respect to the number of deals and to deal values. The coefficient on the aggregate Price to Book ratio is negative and significant at least at the 10% level, in all our specifications but one. Also in this case, shifts in valuations have a substantial economic impact on the relative contribution of financial sponsors to the total number and volume of deals. In particular, a one standard deviation increase in the EUROSTOXX 50 index Price to Book ratio corresponds to a 2.7% drop in the relative contribution of financial sponsors to the number of deals and a 5.4% drop in their share of aggregate deal value. The magnitude of these effects is respectively -3.1% and -6.4% when we consider the subsample of deals for which cash is used as the only means of payment.

Also these findings are consistent with the evidences provided by Martos-Vila et al. (2013) who find the same link between financial sponsors activity and valuations. We interpret the lack of financial sponsors-related deal flow when valuations are high as evidence of their greater price responsiveness. Indeed an empirical study of Gorbenko and Malenko (2014) shows that financial sponsors, who typically aim for a higher return than strategic buyers to meet the expectations of their investors, are relatively more reluctant to close deals at high valuations and less willing to contribute additional equity to compete with rival bids by corporate buyers.[19] In the first case, financial sponsors would in fact erode the potential capital gain at exit while in the latter case they would dilute their returns. Vice versa corporate buyers have relatively greater pricing power as they can nonetheless afford to close deals at higher valuations: they usually require

[18]More in details, Martos-Vila et al. (2013) calculate the borrowing costs for financial sponsors as the High-yield spread over the 5-year Treasury Yield and the borrowing costs for strategic buyers as the spread between the average rate on commercial and industrial loans and the Federal Funds rate.

[19]In line with this argument, Bargeron et al. (2008) find that public target shareholders receive a 63% higher premium when the acquirer is a public firm rather than a private equity firm

lower rates of return than financial sponsors and they can exploit potential synergies.[20]

IV.II Deal Level Analysis

In order to corroborate our industry level results we further analyze, at the individual deal level, the effects of varying stock and debt market conditions on the likelihood of a deal being backed by a financial sponsor or by a strategic buyer. Moreover, we link our financial variables to the size of the deals they undertake and to the takeover premium they offer. The purpose of this analysis is to shed additional light on the behavior of financial sponsors and strategic buyers under varying market conditions and more specifically to explore different channels through which credit availability, borrowing costs and stock market valuations affect the composition of deal flow. In particular, we are interested in seeing whether the effects that we observe are the result of a crowding out of one type of buyer by the other in a competitive setting or they are rather the consequence of a change in the preferred size of deals undertaken by different types of buyers.

To the extent that targets in our sample are representative of the entire set of investment opportunities of financial sponsors, we can get further insight on the willingness of financial sponsors to acquire a company under varying conditions in financial markets by looking at the odds with which a target in our sample gets acquired by a financial sponsor rather than a strategic buyer across periods characterized by different levels of credit availability and valuations. In particular, if financial market conditions were to affect financial sponsors and strategic buyers in the same way, we would expect the odds of a target being acquired by a financial sponsor rather than a strategic buyer to stay constant over time. On the contrary, a rise or fall of the odds ratio would be interpreted as evidence of the adverse or favourable impact of pricing and debt market conditions on M&A activity by financial sponsors.

We test whether the odds of observing a deal at a given point in time being backed

[20] Although we have in our sample both listed and unlisted targets and buyers, this drop in the relative contribution of financial sponsors is also in line with the argument of Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004) that identify stock market valuations as a trigger of M&A activity for strategic buyers as overvalued acquirers driven by greater perceived synergies bid more and overvalued targets are more willing to accept takeover offers.

by a financial sponsor vary significantly as a consequence of shifts in credit availability, credit risk premia or valuations by means of the following logit model:

$$logit(Y_{i,j,t}) = log(\frac{y_{i,j,t}}{1 - y_{i,j,t}}) = a + bX_t + \nu_j + e_{i,j,t} \tag{3.2}$$

$Y_{i,t,j}$ in this case is a dummy variable that takes the value of 1 if the deal is backed by a financial sponsors and 0 if it is backed by a strategic buyer. As per our industry-level analysis, independent variables include: $CreditAvailability_t$, which captures the varying conditions on the markets for debt, $CreditRiskPremium_t$, which accounts for the extra cost that high yield borrowers have to pay to raise debt, $StockmarketValuations_t$, which captures the level of equity markets valuations and ν_j are target industry fixed effects.

Then, in the same spirit, we test whether the deal size or the takeover premium offered by financial or strategic buyers vary significantly as a consequence of shifts in stock market valuations and debt market conditions with the following linear model:

$$Y_{i,j,t} = a + bX_t + \nu_j + e_{i,j,t} \tag{3.3}$$

$Y_{i,t,j}$ is respectively the deal value (logarithmic transformation) or the takeover premium offered. A comparative growth or decline in the takeover premium may explain variations in the relative proportion of deals undertaken by financial sponsors and strategic buyers, while variations of the corresponding shares of deal volumes between financial sponsors and strategic buyers may be the consequence of a comparative growth or reduction in the deal size.

Results

In this section we present the main results and discuss the main findings of our analysis at deal level. Each panel in Table 4 reports the coefficients and standard errors (in parenthesis, clustered by industry) for our models estimation. In particular, in Panel A we consider all deals in our sample, independently of the method of payment, while

Panel B reports our models estimates for a subsample including only deals settled by means of cash payment.[21]

—Insert Table 4 about here—

Column (1) reports the estimates of our logit model with industry-level fixed effects for the odds of observing a deal at a given point in time being backed by a financial sponsor rather than a strategic buyer. We find that, consistent with our evidences at the industry level, a larger yield spread between high yield and investment grade issuers negatively affects M&A activity by financial sponsors. Indeed, the likelihood that an acquisition is backed by a financial sponsor drops when the extra cost of borrowing for financial sponsors relative to strategic buyers increases. The coefficient on the yield spread is negative and significant at the 1% level. In particular, over the entire sample, for a standard deviation increase in the yield spread the log odds of a deal being backed by a financial sponsor drop by approximately 1/3, or equivalently a 3.0% drop in its likelihood when variables are set to their means. The effects are similar when we consider cash bids only. For a standard deviation increase in the yield spread the log odds of a deal being backed by a financial sponsor drop by approximately 1/3, or equivalently a 3.5% drop in its likelihood when variables are set to their means.

This evidence confirms our interpretation that financial sponsors' M&A activity is affected by their higher borrowing costs relative to strategic buyers: when increasing yield spread reduces the benefits of financial leverage, the likelihood of a deal being backed by a financial sponsor declines. As a consequence, strategic buyers with higher pricing power crowd out financial sponsors from the market for corporate control.

With the aim to further understand the results of our logit model, in Column (2) and Column (3) we report OLS regression estimates of the takeover premium over our variables of interest for the subsamples of deals respectively backed by financial sponsors and strategic buyers. We find that the yield spread has a substantial effect on the takeover premium of deals backed by strategic buyers, but not for those backed by

[21] In Panel A we have 11 deals backed by financial sponsors for which the method of payment is undisclosed (8 deals) or a combination of stock and cash (3 deals). As shown in Panel B, when excluding these 11 deals, results do not change.

financial sponsors. Wald tests of parameters across regressions (2) and (3) reject the null hypothesis of equivalent effects across subsamples at the 1% level. The corresponding coefficient is positive and significant at the 1% level. In terms of economic significance a one standard deviation increase in the yield spread corresponds to a 5.4% increase in the takeover premium which would be equivalent to approximately an increase by $43 million for the average deal in our sample. The magnitude of this effect is 4.8% when we consider the subsample of deals for which cash is used as the only means of payment, which would correspond to approximately an increase of $39 million for the average deal in our sample.

Our findings may be interpreted as following: on the one hand, strategic buyers may increase the takeover premium they offer when the yield spread widens because they bid more aggressively. On the other hand, the takeover premium may increase as a consequences of decreasing target prices. Interestingly, when we regress the Equity to Book Value transaction multiple over our three variables of interests for the strategic buyers' subsample, we don't find any significant relation between the Equity to Book Value multiple and the yield spread. Thus, the observed positive relation between the yield spread and the takeover premium is not due to the fact that strategic buyers bid more aggressively (with respect to the book value), but is rather due to the fact that stock market prices are decreasing and the takeover premium is consequently higher.[22] Therefore, the crowding out effect we observe at the industry level (the relative number of deals of strategic buyers increases when the yield spread increases), which is further confirmed by our deal level analysis, does not depend on the bidding aggressiveness of strategic buyers; financial sponsors "participate" less to the M&A market, probably because it's more costly for them to finance their deals with external debt.

While the odds of a deal being backed by financial sponsors and strategic buyers respond to the yield spread, they do not seem to differ in their responsiveness to shifts in credit availability and stock market valuations (Column (1)). The corresponding

[22]These results are consistent with our findings in Table 4, Panel A, considering the whole sample: the takeover premium paid by strategic buyers increases when the Price to Book ratio decreases

coefficients are of the expected sign but we cannot reject the null hypothesis that different types of buyers are equally affected by stock or debt market conditions, as the odds of a deal being backed by a financial sponsor remain constant over time.

One possible explanation could be that at the deal level many additional target- or deal-specific variables may combine to determine the likelihood of a deal being backed by a financial sponsor or strategic buyer together with financial market conditions. Indeed, the potential growth of the target or the level of the expected synergies; as well as how long it would take to reap the benefits of improved performance or the gains from the realization of the synergies; or the capacity of the target to service the additional debt burden are just a few examples of variables that could alter the appeal of a deal to different types of buyers. Therefore, unobserved deal level characteristics may then offset the impact of financial market conditions on the likelihood of a deal being backed by a financial sponsor or strategic buyer.

An alternative explanation could be that shifts in credit availability and stock market valuations affect the relative contribution of financial sponsors to M&A deal flow through changes in the size of deals undertaken by different types of buyers rather than by their willingness to realize a transaction. In order to explore this channel and reconcile our deal-level analysis with results at the industry level, Column (4) and Column (5) report OLS regression estimates of deal size over our variables of interest for the subsamples of deals respectively backed by financial sponsors and strategic buyers. Indeed, we find that credit availability and stock market valuation have substantial effects on the size of deals backed by strategic buyers, but not for those backed by financial sponsors. More specifically, for increasing Price to Book ratio the coefficient for financial sponsors is also positive yet not significative. These observed features may be the consequence, at least partially, of mechanical effect: in fact, when stock market valuations increase, deal size shall increase to some extent mechanically too. Wald tests of parameters across regressions (4) and (5) reject the null hypothesis of equivalent effects across subsamples at the 1% level. Moreover, financially constrained strategic buyers reduce

the size of the deals they undertake when available credit is scarcer. The corresponding coefficient is negative and significant at the 1% level. In terms of economic significance a one standard deviation increase in the Euribor rate corresponds to a 13.2% reduction in deal size which would be equivalent to approximately a drop of $107 million for the average deal in our sample. The magnitude of this effect is 20.9% when we consider the subsample of deals for which cash is used as the only means of payment, which would correspond to a drop of approximately $169 million for the average deal in our sample. The size of deals backed by strategic buyers increases instead with higher stock market valuations. The corresponding coefficient is positive and significant at the 1% level. In terms of economic significance a one standard deviation increase in the Price to Book ratio corresponds to a 19.5% growth in deal size which would be equivalent to approximately a rise of $158 million for the average deal in our sample. The magnitude of these effect is 30.9% when we consider the subsample of deals for which cash is used as the only means of payment, which would correspond to approximately an increase of $251 million for the average deal in our sample.

IV.III Discussion of results

Overall the results of our empirical analysis suggest that deal flows for different types of buyers are not synchronous and the relative composition of deal flow changes in response to varying market conditions. In particular, we find that the relative contribution of financial sponsors to the total volume of deals grows when the availability of credit increases and when the gap in the cost of borrowing for financial sponsors narrows, while it reduces when stock market valuations rise. Thus, evidence is consistent with our first and second hypotheses as both types of bidders respond to shifts in their cost of borrowing but financial sponsors seem less sensitive than strategic buyers to overall credit tightness. On the other hand, though, evidence suggests that financial sponsors seem more price sensitive as their inability to exploit synergies limits their pricing power compared to strategic buyers, in line with our third hypothesis.

However, while the yield spread affects the relative willingness of financial sponsors and strategic buyers to embark on a transaction, credit availability and stock market valuations affect the size of deals realized by different types of buyers. In particular, our results are consistent with a framework in which financial sponsors reduce their appetite for deals when their borrowing costs relative to strategic buyers increase, as their returns from leveraging up transactions reduce and due to their limited ability to adjusts takeover premiums upwards to match those offered by strategic buyers. On the other hand, credit availability does not seem to affect the relative propensity of different buyers to realize a transaction but rather the size of the deals by strategic buyers. In particular, when credit is abundant strategic buyers become less financially constrained and target larger deals. Conversely, when credit is scarce financially constrained strategic buyers refocus their M&A activity on smaller deals. As far as stock market valuations are concerned, also in this case target firm valuations do not seem to affect the relative propensity of different buyers to realize a transaction but rather the size of the deals targeted by strategic buyers. Indeed, high valuations boost comparatively more the value of deals realized by strategic buyers that, as shown in Table 2, pay on average larger takeover premiums.

V Conclusions

Financial sponsors activity has represented an integral part of the European and global economy in the last three decades. Still, in the past years financial sponsors related deal flow has been relatively modest if compared with total M&A activity. This is surprising when looking at some of M&A's fundamental determinants, as availability of credit, economic growth and stock markets performance. Financial and strategic buyers differ over several dimensions and have different strategic goals. In this paper we have analyzed why the portion of financial buyers over total deal making activity varies in the time series. In particular, we have linked financial sponsors and strategic buyers activity to credit availability, credit risk premia and stock market valuations in

an effort to shed light on their possibly conflicting effects on the composition of deal flow. This question is important because the effect on corporations eventually acquired or merged differ depending upon the bidder type.

We have shown within an euro area sample several non trivial implications related to the competition of financial sponsors and strategic buyers. The picture that emerges from our analysis confirms our intuition that there is a conflict between the pressure to invest and the pressure not to overpay and that financial sponsors and strategic buyers are differently influenced by these two forces. Indeed, possibly because of the pressure to invest and the need to lever up transactions to achieve the high returns required by their investors, financial sponsors are relatively slow to react to credit availability, while their short term investment horizon combined with their inability to capture synergies make them relatively more responsive to high company valuations, as overpayment would hinder their returns. Intuitively, we also find that increasing differential borrowing costs between financial sponsors and strategic buyers benefit the latter in the market for corporate control.

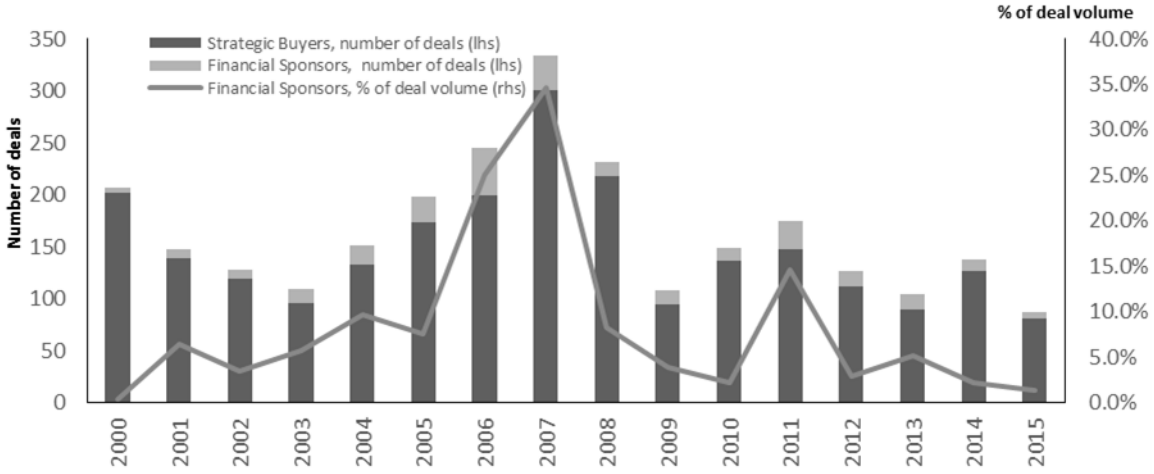

Figure 1: Euro area deals breakdown (number and volume), Strategic vs Financial

Table 3.1: Deals characteristics

This table reports summary statisics on the deal characteristics for the whole sample and for subsamples of deals realized respectively by strategic buyers and financial sponsors. Transaction size represents the value of the deal as announced in EUR million. Cash payment represents the fraction of deals which is settled only by means of cash. It is based on an indicator variable that takes the value of 1 if cash is the only means of payment and 0 otherwise. Premium represents the percentage difference between the offer price and the undisturbed market price of the target before the announcement, Ev/Ebitda is the ratio between Transaction Value and the Trailing 12 months Ebitda, and EqV-to-B is the ratio between Equity Market Value and Equity Book Value. The variables Takeover premium, TV/Ebitda and EqV-to-B have been winsorized at the 2.5% level on both sides to drop outliers. T-tests of differences in deal characterstics across subsamples of deals realized by strategic buyers and financial sponsors are shown in the last row of each Panel. The superscripts *,**,*** denote significance at the 10%, 5% and 1% levels respectively.

Panel A: Transaction size						
	N	Mean	Median	StDev	Min	Max
All sample	2560	812.2	160.0	3130.4	32.0	73304.8
Strategic Buyers	2302	807.7	159.4	3109.3	32.0	73304.8
Financial Sponsors	258	852.5	170.2	3319.2	35.0	36768.1
Differences across buyer types		-44.8				
Panel B: Cash payment						
All sample	2560	0.75	1.00	0.43	0.00	1.00
Strategic Buyers	2302	0.73	1.00	0.44	0.00	1.00
Financial Sponsors	258	0.96	1.00	0.20	0.00	1.00
Differences across buyer types		-0.23***				
Panel C: Takeover premium						
All sample	709	27.5%	22.8%	26.6%	-14.7%	107.2%
Strategic Buyers	669	28.1%	23.2%	27.2%	-14.7%	107.2%
Financial Sponsors	40	17.2%	18.8%	15.7%	-5.1%	47.3%
Differences across buyer types		10.8***				
Panel D: EV/EBITDA						
All sample	660	14.5	10.1	15.8	2.0	84.9
Strategic Buyers	616	14.8	10.2	16.2	2.0	84.9
Financial Sponsors	44	10.1	9.1	5.5	3.2	26.0
Differences across buyer types		4.7*				
Panel E: EqV-to-B						
All sample	870	4.8	2.7	6.1	0.6	32.0
Strategic Buyers	789	4.5	2.7	5.7	0.6	32.0
Financial Sponsors	81	7.1	3.4	8.9	0.7	32.0
Differences across buyer types		-2.6***				

Table 3.2: Summary statistics and correlations

Panel A of this table reports summary statistics of our independent variables. $CreditAvailability_t$ is proxied by the end of the year Euro area Euribor 3-month rate, provided by a panel of banks from EU countries and international banks. $CreditRiskPremium_t$ is proxied by the High Yield spread over the Corporate Bond Yield, which is calculated as the difference between the Barclays Corporate European High Yield Bond Index and the FTSE Corporate European with 10+ Years Maturity Yield Bond Index. $StockValuations_t$ is proxied by the Price to Book ratio of the EUROSTOXX 50 index. Since Datastream does not provide the observation for the year 2000, we complement the series with the EUROSTOXX 600 Price to Book ratio. Panel B of this table reports correlations among our independent variables over our sample period.

Panel A: summary statistics

Variable:	Mean	Median	StDev	Min	Max
Credit Availability	2.09%	2.16	1.62%	-0.13%	4.94%
Credit Risk Premium	5.78%	3.59	4.95%	1.60%	20.47%
Stock Market Valuations	1.95	1.89	0.64	1.05	3.14

Panel B: correlations

	Credit Availability	Credit Risk Premium	Stock Market Valuations
Credit Availability	1		
Credit Risk Premium	0.4353	1	
Stock Market Valuations	0.8603	0.5178	1

Table 3.3: Model estimation, Industry level

This table reports coefficients and standard errors (in parenthesis) of industry-level panel regressions with clustered standard errors at the industry level of a model that, when it includes industry fixed effects, has the following form: $Y_{j,t} = a + bX_t + \nu_j + e_{j,t}$. In Panel A we consider all the deals in our sample, independently of the payment method. In Panel B we consider deals for which cash is the only means of payment. In the first two columns of each panel the dependent variable is the fraction of deals by financial sponsors in a given industry over the total deal flow in the same industry measured on the basis of the number of deals. In the last two columns the dependent variable is instead the fraction of deals by financial sponsors in a given industry over the deals in the same industry measured on the basis of the value of deals. $CreditAvailability_t$ is proxied by the end of the year Euro area Euribor 3-month rate as provided by the European Central Bank. $CreditRiskPremium_t$ is proxied by the High Yield spread over the Corporate Bond Yield, which is calculated as the difference between the Barclays Corporate European High Yield Bond Index and the FTSE Corporate European with 10+ Years Maturity Yield Bond Index. $StockValuations_t$ is proxied by the Price to Book ratio of the EUROSTOXX 50 index. Since Datastream does not provide the observation for the year 2000, we complement the series with the EUROSTOXX 600 Price to Book ratio. All regressions include a constant term (unreported). The superscripts *,** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A: All sample				
	(1)	(2)	(3)	(4)
Credit Availability	1.2468	1.2468	6.1772***	6.1772***
	(0.8205)	(0.7801)	(2.0347)	(2.3747)
Credit Risk Premium	-0.4084***	-0.4084***	-0.6987**	-0.6987*
	(0.1469)	(0.1684)	(0.3466)	(0.4221)
Stock Market Valuations	-4.2664*	-4.2664	-8.4628**	-8.4628*
	(2.3995)	(2.9532)	(4.2087)	(4.5688)
Industry FE	NO	YES	NO	YES
Observations	128	128	128	128
R2	0.0760	0.0975	0.1488	0.1629
Panel B: Cash only				
	(1)	(2)	(3)	(4)
Credit Availability	1.2507	1.2507	6.6147***	6.6147***
	(0.9585)	(0.8852)	(2.3203)	(2.5934)
Credit Risk Premium	-0.4864***	-0.4864***	-0.8507**	-0.8507*
	(0.1731)	(0.1889)	(0.3793)	(0.4743)
Stock Market Valuations	-4.7835*	-4.7835	-9.9848**	-9.9848*
	(2.7725)	(3.6051)	(4.9800)	(5.5506)
Industry FE	NO	YES	NO	YES
Observations	128	128	128	128
R2	0.0702	0.0896	0.1212	0.1366

Table 3.4: Model estimation, Deal Level

This table reports coefficients, Wald test values (in parenthesis in column 1) and t-stats (in parenthesis in columns 2 to 5) of our deal level analysis. Standard errors are clustered by industry. In Panel A we consider all the deals in our sample, independently of the payment method. In Panel B we consider deals for which cash is the only means of payment. In column (1) we estimate a deal-level logit regressions with industry fixed effects of the following model: $Y_{i,j,t} = a + bX_t + \nu_j + e_{i,j,t}$. The dependent variable is a dummy variable that takes the value of 1 if the deal is backed by a financial sponsor and 0 if it is backed by a strategic buyer. In columns (2) to (5) we estimate the following linear model with ordinary least squares (OLS) and industry fixed effects: $Y_{i,j,t} = a + bX_t + \nu_j + e_{i,j,t}$. In column (2) and (3) the dependent variable is the takeover premium over the trading price at the announcement date, while in column (4) and (5) the dependent variable is the logaritmic transformation of the deal size. In columns (2) and (4) we analyze the subsample of deals for which the acquirer is a financial sponsor, while in columns (3) and (5) we analyze the subsample of deals for which the acquirer is a strategic buyer. $CreditAvailability_t$ is proxied by the end of the year Euro area Euribor 3-month rate as provided by the European Central Bank. $CreditRiskPremium_t$ is proxied by the High Yield spread over the Corporate Bond Yield, which is calculated as the difference between the Barclays Corporate European High Yield Bond Index and the FTSE Corporate European with 10+ Years Maturity Yield Bond Index. $StockValuations_t$ is proxied by the Price to Book ratio of the EUROSTOXX 50 index. Since Datastream does not provide the observation for the year 2000, we complement the series with the EUROSTOXX 600 Price to Book ratio. All regressions include a constant term (unreported). The superscripts *,** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A: All sample					
	(1)	(2)	(3)	(4)	(5)
Credit Availability	0.0458	-1.6554	0.5517	0.1459	-0.0812***
	(0.0696)	(1.5407)	1.1822	(0.0898)	(0.0211)
Credit Risk Premium	-0.0756***	-0.7192	1.0856***	0.0106	-0.0094
	(0.0197)	(0.9356)	(0.2659)	(0.0136)	(0.0083)
Stock Market Valuations	-0.1339	1.5738	-4.8612*	0.1935	0.3040***
	(0.2295)	(3.9015)	(2.8710)	(0.3047)	(0.0567)
Industry FE	YES	YES	YES	YES	YES
Observations	2560	40	669	258	2302
R2	0.0459	0.2287	0.0645	0.1133	0.0333
Panel B: Cash only					
	(1)	(2)	(3)	(4)	(5)
Credit Availability	0.0085	-1.6554	-0.1242	0.1311	-0.1288***
	(0.0676)	(1.5407)	(1.0808)	(0.0954)	(0.0253)
Credit Risk Premium	-0.0695***	-0.7192	0.9704***	0.0113	-0.0117
	(0.0180)	(0.9356)	(0.2622)	(0.0124)	(0.0082)
Stock Market Valuations	-0.0317	1.5738	-2.6327	0.1967	0.4829***
	(0.2162)	(3.9015)	(2.6627)	(0.3265)	0.0647
Industry FE	YES	YES	YES	YES	YES
Observations	1932	40	509	247	1685
R2	0.0433	0.2287	0.0675	0.1093	0.0364

Bibliography

Acemoglu, D., Aghion, P., and Zilibotti, F. (2003). Vertical integration and distance to frontier. *Journal of the European Economic Association*, 1(2-3):630–638.

Acharya, V. and Xu, Z. (2016). Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics*.

Acharya, V. V. and Subramanian, K. V. (2009). Bankruptcy codes and innovation. *Review of financial studies*, 22(12):4949–4988.

Admati, A. R. and Pfleiderer, P. (1994). Robust financial contracting and the role of venture capitalists. *The Journal of Finance*, 49(2):371–402.

Aghion, P., Van Reenen, J., and Zingales, L. (2013). Innovation and institutional ownership. *The American Economic Review*, 103(1):277–304.

Allen, F. and Gale, D. (1999). Diversity of opinion and financing of new technologies. *Journal of financial intermediation*, 8(1):68–89.

Amess, K., Stiebale, J., and Wright, M. (2016). The impact of private equity on firms patenting activity. *European Economic Review*, 86:147–160.

Amore, M. D., Schneider, C., and Žaldokas, A. (2013). Credit supply and corporate innovation. *Journal of Financial Economics*, 109(3):835–855.

Atanassov, J. (2013). Do hostile takeovers stifle innovation? Evidence from antitakeover legislation and corporate patenting. *The Journal of Finance*, 68(3):1097–1131.

Axelson, U., Jenkinson, T., Strömberg, P., and Weisbach, M. S. (2013). Borrow cheap, buy high? The determinants of leverage and pricing in buyouts. *The Journal of Finance*, 68(6):2223–2267.

Ayyagari, M., Maksimovic, V., et al. (2007). Firm innovation in emerging markets. 4157.

Azoulay, P. and Lerner, J. (2012). Technological innovation and organizations.

Bakke, T.-E. and Whited, T. M. (2010). Which firms follow the market? An analysis of corporate investment decisions. *Review of Financial Studies*, 23(5):1941–1980.

Balasubramanian, N. and Sivadasan, J. (2011). What happens when firms patent? New evidence from us economic census data. *The Review of Economics and Statistics*, 93(1):126–146.

Bargeron, L. L., Schlingemann, F. P., Stulz, R. M., and Zutter, C. J. (2008). Why do private acquirers pay so little compared to public acquirers? *Journal of Financial Economics*, 89(3):375–390.

Benfratello, L., Schiantarelli, F., and Sembenelli, A. (2008). Banks and innovation: Microeconometric evidence on italian firms. *Journal of Financial Economics*, 90(2):197–217.

Bergemann, D. and Hege, U. (1998). Venture capital financing, moral hazard, and learning. *Journal of Banking & Finance*, 22(6):703–735.

Berger, A. N., Molyneux, P., and Wilson, J. O. (2014). The oxford handbook of banking.

Bernstein, S. (2015). Does going public affect innovation? *The Journal of Finance*, 70(4):1365–1403.

Bernstein, S., Giroud, X., and Townsend, R. R. (2015). The impact of venture capital monitoring. *The Journal of Finance*.

Bond, S., Hawkins, M., and Klemm, A. (2005). Stamp duty on shares and its effect on share prices. *FinanzArchiv: Public Finance Analysis*, 61(3):275–297.

Boucly, Q., Sraer, D., and Thesmar, D. (2011). Growth LBOs. *Journal of Financial Economics*, 102(2):432–453.

Braggion, F. and Ongena, S. (2015). In the end there was banking sector deregulation. And it did matter. It spurred firms to add banks and borrow more. *Working paper*.

Bravo-Biosca, A. (2007). Essays on innovation and finance.

Brown, J. R., Fazzari, S. M., and Petersen, B. C. (2009). Financing innovation and growth: Cash flow, external equity, and the 1990s r&d boom. *The Journal of Finance*, 64(1):151–185.

Chambers, D. and Dimson, E. (2009). Ipo underpricing over the very long run. *The Journal of Finance*, 64(3):1407–1443.

Chan, Y.-S. (1983). On the positive role of financial intermediation in allocation of venture capital in a market with imperfect information. *The Journal of Finance*, 38(5):1543–1568.

Chava, S., Oettl, A., Subramanian, A., and Subramanian, K. V. (2013). Banking deregulation and innovation. *Journal of Financial Economics*, 109(3):759–774.

Clarke, J., Dass, N., and Patel, A. (2015). Is there a dark side to analyst coverage? A closer look at innovation.

Clemons, E. K. and Weber, B. (1989). London's big bang: a case study of information technology, competitive impact, and organizational change. 4:233–242.

Cornaggia, J., Mao, Y., Tian, X., and Wolfe, B. (2015). Does banking competition affect innovation? *Journal of Financial Economics*, 115(1):189–209.

Cornelli, F. and Yosha, O. (2003). Stage financing and the role of convertible securities. *The Review of Economic Studies*, 70(1):1–32.

Da Rin, M., Hellmann, T. F., and Puri, M. (2011). A survey of venture capital research.

De la Fuente, A. and Marín, J. (1996). Innovation, bank monitoring, and endogenous financial development. *Journal of Monetary Economics*, 38(2):269–301.

Degeorge, F., Martin, J., and Phalippou, L. (2016). On secondary buyouts. *Journal of Financial Economics*, 120(1):124–145.

Dittmar, A., Li, D., and Nain, A. (2012). It pays to follow the leader: acquiring targets picked by private equity. *Journal of Financial and Quantitative Analysis*, 47(05):901–931.

Faccio, M. and Masulis, R. W. (2005). The choice of payment method in european mergers and acquisitions. *The Journal of Finance*, 3:1345–1388.

Fang, V. W., Tian, X., and Tice, S. (2014). Does stock liquidity enhance or impede firm innovation? *The Journal of Finance*, 69(5):2085–2125.

Ferreira, D., Manso, G., and Silva, A. C. (2014). Incentives to innovate and the decision to go public or private. *Review of Financial Studies*, 27(1):256–300.

Gemmill, G. (1996). Transparency and liquidity: A study of block trades on the London stock exchange under different publication rules. *The Journal of Finance*, 51(5):1765–1790.

Goldsmith, R. W. (1969). Financial structure and development.

Gompers, P. A. and Lerner, J. (2004). The venture capital cycle.

Gonzalez-Uribe, J. (2014). Venture capital and the diffusion of knowledge. *Available at SSRN 2405362*.

Gorbenko, A. S. and Malenko, A. (2014). Strategic and financial bidders in takeover auctions. *The Journal of Finance*, 69(6):2513–2555.

Greenwood, J. and Jovanovic, B. (1989). Financial development, growth, and the distribution of income.

Greenwood, J. and Smith, B. D. (1997). Financial markets in development, and the development of financial markets. *Journal of Economic Dynamics and Control*, 21(1):145–181.

Griliches, Z., Pakes, A., and Hall, B. H. (1986). The value of patents as indicators of inventive activity.

Haddad, V., Loualiche, E., and Plosser, M. C. (2013). Buyout activity: The impact of aggregate discount rates. *FRB of New York Staff Report*, (606).

Hall, B., Helmers, C., Rogers, M., and Sena, V. (2014). The choice between formal and informal intellectual property: a review. *Journal of Economic Literature*, 52(2):375–423.

Hall, B. H. (1993). The stock market's valuation of R&D investment during the 1980's. *The American Economic Review*, 83(2):259–264.

Hall, B. H., Helmers, C., Rogers, M., and Sena, V. (2013). The importance (or not) of patents to uk firms. *Oxford Economic Papers*, 65(3):603–629.

Hall, B. H., Jaffe, A., and Trajtenberg, M. (2005). Market value and patent citations. *RAND Journal of economics*, pages 16–38.

Hall, B. H. and Lerner, J. (2010). The financing of r&d and innovation. *Handbook of the Economics of Innovation*, 1:609–639.

Hansen, R. G. (1987). A theory for the choice of exchange medium in mergers and acquisitions. *Journal of business*, pages 75–95.

Harford, J. (2005). What drives merger waves? *Journal of financial economics*, 77(3):529–560.

Harhoff, D., Narin, F., Scherer, F. M., and Vopel, K. (1999). Citation frequency and the value of patented inventions. *Review of Economics and statistics*, 81(3):511–515.

Hege, U., Lovo, S., Slovin, M. B., and Sushka, M. E. (2013). Asset sales and the role of buyers: Strategic buyers versus private equity. *Available at SSRN 1787465*.

Hellman, T. (2016). Fostering entrepreneurship: Backing founders or investors? *working paper*.

Hellmann, T. and Puri, M. (2002). Venture capital and the professionalization of start-up firms: Empirical evidence. *The journal of finance*, 57(1):169–197.

Hirukawa, M. and Ueda, M. (2011). Venture capital and innovation: which is first? *Pacific Economic Review*, 16(4):421–465.

Holmstrom, B. (1989). Agency costs and innovation. *Journal of Economic Behavior & Organization*, 12(3):305–327.

Holmstrom, B. and Kaplan, S. N. (2001). Corporate governance and merger activity in the us: Making sense of the 1980s and 1990s.

Hombert, J. and Matray, A. (2012). The real effects of hurting lending relationships: evidence from banking deregulation and innovation. *Unpublished Working Paper, HEC Paris*.

Hsu, P.-H., Tian, X., and Xu, Y. (2014). Financial development and innovation: Cross-country evidence. *Journal of Financial Economics*, 112(1):116–135.

Jensen, M. C. (1997). Eclipse of the public corporation. *Harvard Business Review (Sept.-Oct. 1989), revised*.

Kaplan, S. (1989). The effects of management buyouts on operating performance and value. *Journal of financial economics*, 24(2):217–254.

Kaplan, S. N. (1991). The staying power of leveraged buyouts. *Journal of Financial Economics*, 29(2):287–313.

Kaplan, S. N. and Stein, J. C. (1993). The evolution of buyout pricing and financial structure (or, what went wrong) in the 1980s. *Journal of Applied Corporate Finance*, 6(1):72–88.

Kaplan, S. N. and Strömberg, P. (2009). Leveraged buyouts and private equity. *The Journal of economic perspectives*, 23(1):121–146.

Kerr, I. (1986). Big bang. *Euromoney*.

Kerr, W. R. and Nanda, R. (2014). Financing innovation.

King, R. G. and Levine, R. (1993). Finance, entrepreneurship and growth. *Journal of Monetary economics*, 32(3):513–542.

Kortum, S. and Lerner, J. (2000). Assessing the contribution of venture capital to innovation. *RAND journal of Economics*, pages 674–692.

Lerner, J. and Seru, A. (2015). The use and misuse of patent data: Issues for corporate finance and beyond. *Booth/Harvard Business School Working Paper*.

Lerner, J., Sorensen, M., and Strömberg, P. (2011). Private equity and long-run investment: The case of innovation. *The Journal of Finance*, 66(2):445–477.

Levine, R. (2005). Finance and growth: theory and evidence. *Handbook of economic growth*, 1:865–934.

Levine, R., Lin, C., and Wei, L. (2015). Insider trading and innovation.

Malenko, A. and Malenko, N. (2015). A theory of LBO activity based on repeated debt-equity conflicts. *Journal of Financial Economics*, 117(3):607–627.

Mantovani, A. (2006). Complementarity between product and process innovation in a monopoly setting. *Economics of Innovation and New Technology*, 15(03):219–234.

Martos-Vila, M., Rhodes-Kropf, M., and Harford, J. (2013). Financial vs. strategic buyers. Technical report, National Bureau of Economic Research.

Martynova, M. and Renneboog, L. (2009). What determines the financing decision in corporate takeovers: Cost of capital, agency problems, or the means of payment? *Journal of Corporate Finance*, 15(3):290–315.

Nanda, R. and Nicholas, T. (2014). Did bank distress stifle innovation during the great depression? *Journal of Financial Economics*, 114(2):273–292.

Ostinelli, D. (2016a). The Big Innovation Bang. *Working paper*.

Ostinelli, D. (2016b). Innovation and finance: a survey. *Working paper*.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of financial studies*, 22(1):435–480.

Phalippou, L. and Gottschalg, O. (2009). The performance of private equity funds. *Review of Financial Studies*, 22(4):1747–1776.

Plender, J. (1986). London's big bang in international context. *International Affairs (Royal Institute of International Affairs 1944-)*, 63(1):39–48.

Puri, M. and Zarutskie, R. (2012). On the life cycle dynamics of venture-capital-and non-venture-capital-financed firms. *The Journal of Finance*, 67(6):2247–2293.

Rajan, R. G. and Zingales, L. (1998). Financial dependence and growth. *The American Economic Review*.

Rajan, R. G. and Zingales, L. (2001). Financial systems, industrial structure, and growth. *Oxford review of economic Policy*, 17(4):467–482.

Rajan, R. G. and Zingales, L. (2003). Banks and markets: the changing character of european finance. *Conference paper*.

Rappaport, A. (1989). The staying power of the public corporation. *Harvard business review*, 68(1):96–104.

Rhodes-Kropf, M. and Viswanathan, S. (2004). Market valuation and merger waves. *The Journal of Finance*, 59(6):2685–2718.

Sahlman, W. A. (1990). The structure and governance of venture-capital organizations. *Journal of financial economics*, 27(2):473–521.

Saidi, F. and Zaldokas, A. (2016). The informational value of patents in banking relationships. *Available at SSRN 2715925*.

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. 55.

Seru, A. (2014). Firm boundaries matter: Evidence from conglomerates and r&d activity. *Journal of Financial Economics*, 111(2):381–405.

Shivdasani, A. and Wang, Y. (2011). Did structured credit fuel the LBO boom? *The Journal of Finance*, 66(4):1291–1328.

Shleifer, A. and Vishny, R. W. (2003). Stock market driven acquisitions. *Journal of financial Economics*, 70(3):295–311.

Solow, R. M. (1957). Technical change and the aggregate production function. *The review of Economics and Statistics*, pages 312–320.

Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *The Quarterly Journal of Economics*, pages 655–669.

Strömberg, P. (2008). The new demography of private equity. *The global impact of private equity report*, 1:3–26.

Trajtenberg, M. (1990). A penny for your quotes: patent citations and the value of innovations. *The Rand Journal of Economics*, pages 172–187.

Yu, F. F. (2008). Analyst coverage and earnings management. *Journal of Financial Economics*, 88(2):245–271.

Zingales, L. (2015). Does finance benefit society?